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OPERABLE UNIT 2 RI/FS WORK PLAN
WEST LAKE LANDFILL
BRIDGETON, MISSOURI

Prepared For:

Laidlaw Waste Systems (Bridgeton), Inc.
c/o Bridgeton Sanitary Landfill
13570 St. Charles Rock Road
Bridgeton, Missouri 63044

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April 1995

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LIST OF APPENDICES

1.0 INTRODUCTION

This document presents the Remedial Investigation/Feasibility Study Work Plan for West Lake Landfill Operable Unit 2 (OU-2). The US Environmental Protection Agency (EPA) placed the West Lake Landfill on the National Priorities List (NPL) on August 30, 1990, pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Sec. 9605. The West Lake Landfill is a municipal solid waste landfill.

The EPA identified two (2) operable units at the site. On August 11, 1992, the EPA issued a Special Notice Letter to Rock Road Industries, Inc., Laidlaw Waste Systems, Inc., Cotter Corporation, and the US Department of Energy (collectively referred to as the Respondent Group), informing the Respondent Group of potential liability for releases or threatened releases of hazardous substances from the West Lake Landfill (Operable Unit 1). The Respondent Group and EPA negotiated an *Administrative Order on Consent*, Docket No. VII-93-F-0005 (EPA, 1993b)* and *Statement of Work* to perform a Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit 1.

An *Administrative Order on Consent*, Docket No. VII-94-F-0025 (EPA, 1994b) and *Statement of Work* (AOC and SOW) to perform an RI/FS for OU-2 were negotiated by Laidlaw and the EPA, and executed on December 14, 1994.

The SOW requires the development and submittal of a Work Plan for the implementation of an RI/FS for the site. The Work Plan has been developed to be consistent with the requirements of the AOC and SOW, and EPA guidance (*Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, Streamlining the RI/FS for CERCLA Municipal Landfill Sites, Presumptive Remedy for CERCLA Municipal Landfill Sites*, and other documents listed in Section 8.0 *References*).

* All references contained herein are listed in Section 8.

The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass, collection and/or treatment of landfill gas, and measures to control landfill leachate and affected groundwater at the perimeter of the landfill.

The presumptive remedy guidance does not address exposure pathways outside the source areas nor does it include the long-term groundwater response action. Given the application of the presumptive remedy for this site, this RI/FS Work Plan has been streamlined to address data collection requirements for source containment. Additionally, the RI/FS Work Plan has been designed to collect sufficient data to address the potential for exposure pathways outside the source areas.

The ultimate goal of the RI/FS process at the West Lake Landfill OU-2 is to select a cost-effective remedy (including no action) that mitigates threats to, and provides protection of public health and the environment, consistent with regulatory requirements and guidelines established by the EPA.

The following paragraphs provide an overview of the RI/FS process under CERCLA, the purpose and objectives of the streamlined RI/FS Work Plan, the organization of the RI/FS Work Plan, Quality Assurance, and the study area.

1.1 Overview of the RI/FS Process Under CERCLA

The goal of an RI/FS is to provide the information necessary to: 1) adequately characterize the site; 2) define site dynamics; 3) define risks, and 4) develop the response action (including no action). EPA has allowed for streamlining the process for CERCLA municipal landfill sites. EPA will identify the preferred remedial alternative. After public review of the proposed remedy, the EPA will select the proposed remedy and document the remedy selection process in the Record of Decision (ROD).

Figure 1-1 provides a depiction of the major components of the RI/FS process.

The ultimate goal of RI/FS activities at the West Lake Landfill is to identify the need for, and to select, if necessary, a cost-effective remedial alternative that mitigates threats to, and provides protection of, public health, welfare, and the environment, consistent with regulatory requirements and guidelines established by the EPA.

1.2 Purpose and Objectives

This RI/FS Work Plan is a scoping document that is intended to divide the broad project goals into manageable tasks. This Work Plan presents the rationale for specific work tasks that will be integral components of the streamlined RI/FS. The Work Plan also provides a detailed description of the work tasks and the methodology that will be used to complete the work.

The broad objectives (or goals) described in the AOC (EPA, 1994b) for the OU-2 RI/FS are:

- To determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants, or contaminants at or from the site; and,
- To determine and evaluate alternatives for remedial action (if any) to prevent, mitigate, or otherwise respond to or remedy any release or threatened release of hazardous substances, pollutants, or contaminants at or from the site.

A series of specific objectives have been developed for the RI/FS based on the AOC requirements. These include:

Remedial Investigation

- Implement and document field support activities;
- Investigate and define site physical and biological characteristics;
- Define sources of contamination;
- Characterize site geologic, hydrologic, and hydrogeologic conditions;

- Determine the nature and extent of contaminants;
- Develop a conceptual site model which identifies contaminant migration pathways, and potential receptors; and,
- Perform a baseline risk assessment to evaluate the level of risks to human health and the environment.

Treatability Study

Evaluate the need for treatability studies.

Feasibility Study

- Develop and screen remedial technologies;
- Assemble remedial action alternatives; and,
- Conduct a detailed analysis of remedial alternatives.

1.3 Organization of the RI/FS Work Plan

This RI/FS Work Plan conforms with EPA guidance for CERCLA activities at municipal landfills (EPA, 1990, 1991e, and 1993a). The Work Plan consists of eight sections and accompanying appendices. Section 1 is the introduction to the Work Plan. Section 2 presents the history and current knowledge of the site conditions.

Section 3 provides an initial evaluation of site characteristics based on data from previous investigations and presents a conceptual site model of potential contaminant pathways and receptors. Contaminant sources, quantities, and characteristics are defined based on existing data. The current knowledge of impacts to media from various sources is presented. Preliminary identification of applicable or relevant and appropriate requirements (ARARs) is also presented.

Section 4 provides the rationale and detailed description of RI/FS activities. Data needs and data quality required to attain these objectives are defined.

Section 5 presents activities necessary to conduct the RI/FS. Because the RI/FS process is iterative in nature, early activities are specifically defined while later activities will be fully developed depending on information and data gathered early in the RI. Section 6 provides an anticipated schedule for conducting and completing the RI/FS.

Section 7 identifies the project management plan, including project organization and responsibilities, reporting requirements, and project tracking requirements. Section 7 is a data management plan describing the methods to be used in managing the data generated during the RI/FS investigation. This section includes a discussion and evaluation of various existing databases and their potential usefulness and limitations. Section 8 is a list of cited references used in developing the Work Plan.

Attachments to the Work Plan include support project plans that are necessary to manage, conduct, and control the RI/FS project. The support project plans include:

Appendix A: *Sampling and Analysis Plan*, consisting of the *Field Sampling Plan*, and *Quality Assurance Project Plan*

Appendix B: *Health and Safety Plan*

The Health and Safety Plan (Appendix B) is being submitted concurrently with the RI/FS Work Plan. Consistent with the AOC for OU-2 (EPA, 1994b), the Sampling and Analysis Plan will be submitted at a later date as discussed in Section 6.

1.4 Quality Assurance

The quality assurance objective for the Work Plan and its appended project plans is to ensure that the data and results obtained are sufficiently accurate and reliable to support decisions associated with site characterization, risk assessment, and evaluation and selection of remedial alternatives. RI/FS activities at the West Lake Landfill site will be conducted in accordance with applicable quality assurance guidelines.

1.5 Study Area

The study area to be included in the RI/FS for the West Lake Landfill Operable Unit 2 will generally include the area bounded by St. Charles Rock Road on the north, Taussig Road on the east, Old St. Charles Rock Road on the south and west, and various interspersed undeveloped properties. A complete description of the site location, and a site location map, is provided in Section 2.1.1. Operable Unit 2 encompasses the entire West Lake Landfill site, except the two areas comprising Operable Unit 1. The entire site measures approximately 212 acres. OU-1 measures approximately 37 acres. OU-2 therefore consists of about 175 acres. OU-2 includes the following industrial operations:

- An active solid waste landfill comprising approximately 52 acres. The active solid waste landfill operates under a Missouri Department of Natural Resources solid waste permit and is subject to the appropriate State of Missouri regulatory requirement;
- An inactive municipal solid waste landfill area;
- A concrete batch plant;
- An asphalt plant; and,
- An automobile repair shop.

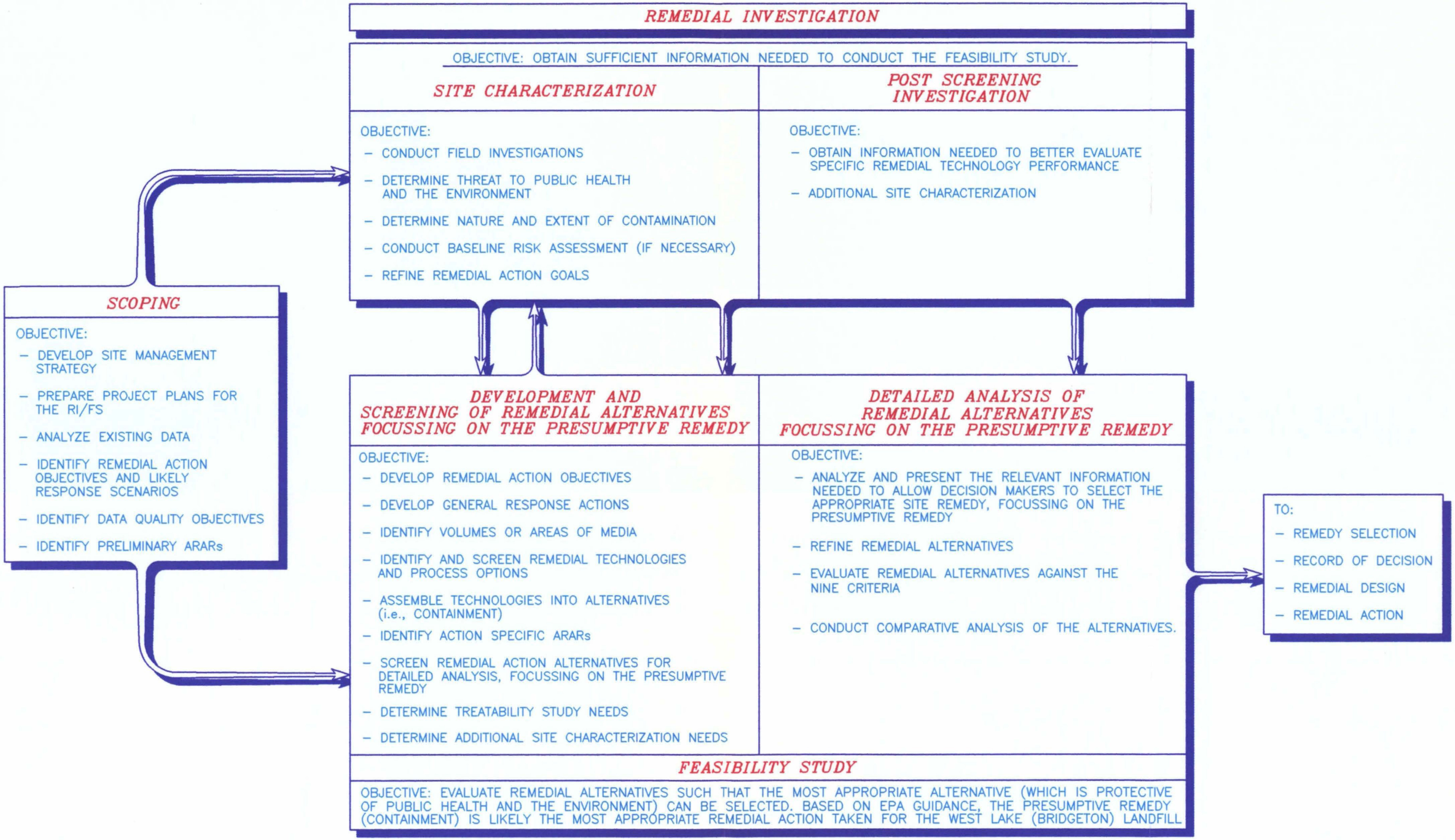
Laidlaw Waste Systems (Bridgeton) Inc., the sole respondent for the OU-2 RI/FS, owns only a portion of the site, as discussed more completely in Section 2.

1.6 Key Assumptions

In order to prepare the evaluations and plans presented in this Work Plan, certain assumptions have been made. Significant assumptions utilized to develop this Work Plan are described below. Material changes to the evaluations and plans presented in this Work Plan may result from modification of any of the key assumptions.

- It is assumed that no material errors are present in data from previous investigations utilized in developing this Work Plan. Certain qualifications about data generated in previous investigations have been made in this Work Plan. Laidlaw Waste Systems (Bridgeton) Inc. and Golder Associates Inc. cannot evaluate the validity of this data beyond the available information and do not provide and guarantee of the validity of these data.

- It is assumed that the information describing the historical operations at the West Lake Landfill, as described in cited references, is reasonably accurate and complete, and no conditions or contaminants are present at the site other than those identified in cited references.



Golder Associates, Denver, Colorado		TITLE: RI/FS PROCESS		
CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995	JOB NO. 943-2848
		CHECKED CER	SCALE AS SHOWN	DWG. NO./REV. NO. B027
		REVIEWED WEH	FILE NO. 2848B027	FIGURE NO. 1-1

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 Site Description

2.1.1 Location

The West Lake Landfill is located at 13570 St. Charles Rock Road within the City of Bridgeton, in St. Louis County (Figures 2-1 and 2-2). Lambert/St. Louis International Airport is located approximately 4 miles east of the site; downtown St. Louis is about 16 miles to the east. The site is a mixed-use industrial facility, and includes a solid waste disposal facility, asphalt plant, concrete plant, automotive repair and body shop, and an Southwestern Bell switching station.

The landfill is in a mixed use setting, surrounded by industrial development and agriculture. Industrial development is generally nonconforming use with current zoning, but has been grandfathered based on pre-existing use. Figure 2-3 illustrates current zoning. There are isolated residentially zoned areas in the general vicinity. A State of Missouri Court of appeals, Eastern District, Division Two decision (West Lake Quarry and Material Company v. City of Bridgeton, et al.) No. 54007, dated December 6, 1988, held that residential zoning near the site is unconstitutional.

The site is bordered on the north by St. Charles Rock Road (State Highway 180) and on the east by Taussig Road and undeveloped agricultural land. Old St. Charles Rock Road borders the southern and western portions of the site, along with undeveloped land. Property north of the site is moderately developed with commercial retail and manufacturing operations. The Earth City industrial park is adjacent to the site on the south and west.

2.1.2 Historical Operations Summary

The following historical operations summary was derived from McLaren/Hart (1994a) and has been supplemented with other pertinent information. Complete details of the site operational history are provided in Section 2.5 of this Work Plan.

The site was used for agricultural purposes until 1939, when limestone quarrying operations were initiated in the eastern portion of the site. Quarrying continued until economically-recoverable reserves were exhausted in 1988. Mine spoils were deposited on adjacent land immediately to the west of the quarry, within the OU-2 study area. Limestone, concrete, and asphalt processing was conducted on-site during quarry operations; asphalt and concrete activities continue to date. The processing operations were conducted primarily in the central portion of the facility. Concrete processing was conducted in the central and northern portion.

Based on available data, solid waste disposal may have begun at the site as early as 1952 (Midwest, 1994), although many sources cite 1962 as the initiation date for waste disposal. Waste disposal in Missouri was regulated solely by St. Louis County authorities until 1974, when the Missouri Department of Natural Resources (MDNR) was formed. At the West Lake site, the MDNR closed certain waste disposal sites on the northern portion of the site and issued State permits for disposal of sanitary and demolition wastes in other areas. Waste disposal continued during and after cessation of mining activities, using the quarry pits as landfill cells. The MDNR permit areas are highlighted on Figure 2-4 and discussed in detail in Section 2.4.3.2.

Radiological wastes consisting of 700 tons of uranium contained in 8,700 tons of barium sulfate, and mixed with 39,000 tons of soil, were reportedly disposed of in two portions of the site in 1973, now comprising OU-1 (Areas 1 and 2, Figure 2-2). The site was placed on the National Priorities List (NPL) in 1990, based primarily on the presence of radiological isomers and the associated potential for groundwater contamination. Operable Unit 1 is being characterized under *Administrative Order on Consent*, Docket No. VII-93-F-0005 (EPA, 1993b).

To date, OU-1 activities have included preparation of an RI/FS Work Plan and associated documents (McLaren/Hart, 1994a), as well as completion of an overland gamma survey designed to identify the extent of radiological contamination within and near OU-1 Areas 1 and 2 (McLaren/Hart, 1994b).

Characterization of OU-2 is the subject of this Work Plan. References to OU-1 conditions, such as hydrogeologic characteristics and nature and extent of OU-1 contamination, have been made in this Work Plan only when pertinent to OU-2 conditions.

2.1.3 Facilities

Facilities at the West Lake Landfill include inactive and active landfill areas, site office buildings supporting landfill operations, an asphalt batch plant and support buildings, a concrete batch plant, an automotive repair and body shop, and an Southwestern Bell switching station (Figure 2-5). Figure 2-6 depicts groundwater monitoring wells known to exist at the site.

The landfill office is located near the site entrance, south of St. Charles Rock Road. Additional support facilities, such as a maintenance shop, are located in the central portion of the site. The asphalt batch plant and concrete batch plant, described in Section 2.4.2, are also located in the central portion of the site. The automotive repair and body shop, as well as the Southwestern Bell switching station, are located in the southern portion of the site. The asphalt batch plant, concrete plant, automotive repair and body shop, and Southwestern Bell switching station, are not owned or operated by Laidlaw. Laidlaw primarily owns the solid waste disposal areas on the site, with multiple ownership of the remaining areas.

Leachate and landfill gas collection systems have been installed in the active sanitary landfill areas, within the eastern portion of the site (Figure 2-5). The leachate collection system discharges to a synthetically-lined leachate retention pond south of Old St. Charles Rock Road, with subsequent discharge to the local sanitary sewer system. The landfill gas collection system utilizes a flare to burn collected landfill gas. The leachate collection system is discussed in Section 2.5.2; the landfill gas collection system is described in Section 2.5.3.

The active solid waste landfill groundwater monitoring system currently consists of four monitoring wells located around the active sanitary landfill area. Other monitoring wells located throughout and around the perimeter of the site are inactive (i.e., not currently utilized as part of the groundwater monitoring program) (Figure 2-6). A few new monitoring wells are present in the vicinity of an underground storage tank for an investigation conducted by other site tenants. The USTs are located near the asphalt plant. No data was available to Laidlaw relating to these UST wells. Certain currently-inactive, existing groundwater monitoring wells are proposed for inclusion in the OU-1 characterization (McLaren/Hart, 1994a). The groundwater monitoring system is discussed in detail in Section 2.5.5.

2.2 Physical Setting

The following discussions of regional characteristics are based on Miller, et al. (1974) *Water Resources of the St. Louis Area, Missouri* and McLaren/Hart (1994a) *RI/FS Work Plan for the West Lake Site, Bridgeton, Missouri*. Discussions of local characteristics are based on cited sources.

2.2.1 Topography

2.2.1.1 Regional Topography

The St. Louis Metropolitan area is located at the confluence of the Missouri and Mississippi Rivers, and consists of Jefferson, St. Charles and St. Louis Counties in Missouri (Figure 2-2), as well as adjacent counties in Illinois. The northeastern two thirds of St. Charles and St. Louis Counties, and the extreme northeastern part of Jefferson County, lie within the Dissected Till Plains of the Central Lowland physiographic province.

The gently undulating Dissected Till Plains range in elevation from about 450 to 700 feet above mean sea level (MSL). The area was glaciated twice during the Pleistocene era, but the morainal topography typical of adjacent glaciated areas is not present. The till deposits are thin and dissected due to post-Pleistocene erosion.

2.2.1.2 Local Topography

The site lies within the Dissected Till Plains physiographic province described above. Site topography has been subject to change since initiation of quarrying activities in the 1940s and subsequent landfilling beginning in the 1950s. The western portion of the site currently varies in elevation between about 450 and 515 feet MSL (Figure 2-2), due to deposition of mine spoils and waste materials. Undisturbed ground surface at the eastern portion of the site averages about 480 feet MSL. The quarry was excavated to an elevation of about 240 feet MSL near the southern end of the active solid waste facility; current elevation of the daily cover in the southern portion of the active solid waste landfill averages about 340 feet MSL.

2.2.2 Geology

2.2.2.1 Regional Geology

2.2.2.1.1 Unconsolidated Materials

Quaternary deposits in the region are comprised of recent (Holocene) alluvial deposits from the Missouri River, and upland loess and glacial till deposits from Pleistocene glaciation. The alluvial deposits range in thickness from 0 to 150 feet. Loess deposits are up to 110 feet thick, and till deposits are infrequent but occur in layers up to 55 feet thick. Near the site, the overall thickness of the alluvium varies from 0 feet at the contact with the loess immediately east of the site to approximately 100 feet beneath the center of the Missouri River valley, 2 miles west.

The loess is an aeolian (windblown) deposit and consists primarily of silt. The loess was deposited as a blanket over much of Missouri and Illinois during the Pleistocene glacial epoch. The bluffs and hills immediately east of the site are composed of loess in deposits up to 80 feet thick.

2.2.2.1.2 Bedrock

The bedrock stratigraphic sequence in the St. Louis area consists primarily of limestone and dolomite. Geologic deposits range in age from Precambrian to Quaternary-Holocene. A generalized stratigraphic column for the St. Louis area is presented in Table 2-1.

Underlying the Quaternary unconsolidated materials described above are Pennsylvanian-age Missourian, Desmoinesian and Atokan Formations, consisting primarily of shales, siltstones, and sandstones containing silt and clay. The total thickness of the Pennsylvanian system ranges from zero to approximately 375 feet.

The Mississippian series, consisting of the Meramecian, Osagean and Kinderhookian Formations, underlies the Pennsylvanian rocks. These formations consist primarily of limestones with some shales and siltstones. The Meramecian series includes the St. Genevieve Formation (0 to 160 feet thick), St. Louis Limestone (0 to 180 feet thick), Salem Formation (0 to 180 feet thick) and Warsaw Formation (0 to 110 feet thick). The Osagean series consists of the Burlington-Keokuk Limestone (a cherty limestone), and the Fern Glen Formation, consisting of a red limestone and shale. The Burlington-Keokuk Limestone can range in thickness from 0 to 240 feet and the Fern Glen Formation from 0 to 105 feet. The Kinderhookian Formation is an undifferentiated limestone, dolomitic limestone, shale, and siltstone unit ranging in thickness from 0 to 122 feet.

There is an unconformity at the base of the Mississippian formations which is underlain by Devonian units comprised of sandstone, limestone, and shale deposits up to approximately 100 feet thick. An unconformity at the base of the Devonian units is underlain by cherty limestone of Silurian age which is as much as 200 feet thick. Geologic units of Ordovician age underlie the Silurian deposits, and may be up to 2,300 feet thick. Ordovician deposits are primarily limestone, dolomite and shale with some sandstone. Upper Cambrian age deposits, beneath the Ordovician units, consist of cherty dolomite, siltstone, sandstone and shale. Precambrian igneous and metamorphic rocks underlie the Cambrian units.

2.2.2.2 Local Geology

2.2.2.2.1 Unconsolidated Materials

The site is located on the eastern edge of the historic Missouri River valley at the transition between the alluvial flood plain to the west and the loess bluffs to the east (McLaren/Hart, 1994a). The approximate location of the historic edge of the alluvial valley is shown in Figure 2-6. The western portion of the site is located within the historical flood plain and is underlain by up to 100 feet of alluvium. The site is protected from flooding by levees constructed near the Missouri River; during the flood of 1993, the site did not flood. The former limestone quarry is located east of the flood plain and was, before quarry operations, covered by a thin veneer of loess.

Unconsolidated materials at the site vary slightly from regional characteristics. Lutzen and Rockaway (1971) characterize the edge of the alluvial valley in this area as covered with two layers of very thick loess deposits overlying residual soils of varying thicknesses. The upper loess layer, 20 to 30 feet thick, is described as silt-rich, whereas the lower layer, 20 to 50 feet thick, is clay rich. The residual soil layer is composed of clay and partially decomposed limestone bedrock. However, loess materials on the eastern portion of the site actually consist of only a thin veneer of silt-rich loess over bedrock materials. The thick layers of loess described by Lutzen and Rockaway were likely removed by erosion (Banerji, et al., 1984). A relic soil profile 3 to 6 feet thick caps the bedrock.

The alluvium at the site consists of clay, silt, and sand and gravel mixtures. Generally the uppermost sediments (from natural ground surface to between 15 and about 35 feet) are characterized as silt and clay which are derived from periodic flooding of the Missouri River (overbank deposits). Below the fine-grained materials, the sediments are generally coarser-grained and consist primarily of sand and gravel (point bar deposits).

2.2.2.2.2 Bedrock

The Pennsylvanian-age bedrock units described above are absent at the site (McLaren/Hart, 1994a). The uppermost bedrock beneath the site is the Mississippian-age Meramecian series. The series consists of the St. Louis and Salem Formations limestones extending from near the surface to a depth of approximately 250 feet (approximately 190 feet MSL). The limestones are dense, bedded, and contain a minimal amount of chert. Intermittent layers of abundant cherty nodules are observed in the formations. The Warsaw Formation, also Mississippian age, underlies the St. Louis and Salem Formations. In the vicinity of the site, the Warsaw Formation consists of slightly calcareous, dense shale which grades into shaley limestone.

The St. Louis and Salem Formation limestones were mined during quarrying operations at the site. Mining operations extended from ground surface to the top of the Warsaw shale. Subsurface investigations below the level of the Warsaw shale have apparently not been conducted at the site; regional information indicates that the typical thickness of the Warsaw shale is 40 feet.

Bedrock strata beneath the site are nearly horizontal, with a reported dip to the northeast at approximately 0.5 degrees from horizontal (McLaren/Hart, 1994a). Quarry operations extended from the ground surface to the top of the Warsaw Formation. Figure 2-7 shows the inferred bedrock surface contours prior to quarrying, based on information from boring logs.

Regionally, the upper surface of the limestone bedrock is irregular and pitted as a result of karstification (Lutzen and Rockaway, 1971). However, visual observations of the quarry walls indicate that karst activity within the limestone is limited to widening of joints and bedding planes near the bedrock surface.

2.2.3 Hydrogeology

Groundwater is present at and near the site in both unconsolidated materials (alluvium) and bedrock aquifers, as described in the following sections.

2.2.3.1 Alluvial Aquifer

The major alluvial aquifers include the Quaternary age alluvium and the basal parts of the alluvium underlying the Missouri River floodplain. These floodplain alluvial aquifers are typically exposed at the surface and can be as much as 150 feet thick (Miller, et al., 1974).

At the site, groundwater is present in the alluvium under unconfined conditions. Groundwater generally occurs at a depth of 10 feet or less beneath the natural ground surface. The alluvium is saturated to the top of the limestone bedrock. There is apparently no confining bed present along the contact with the underlying limestone.

Groundwater elevations at the site vary on a seasonal basis and generally fluctuate about seven feet (McLaren/Hart, 1994a). Water level rises are associated with periods of high precipitation. Coincident with the precipitation is a rise in the Missouri River stage. EPA requested McLaren/Hart to collect monthly water level data as part of the OU-1 RI during the summer of 1993 during a period of higher than average precipitation. If available, this data will be used in the OU-2 RI hydrogeologic characterization.

2.2.3.1.1 Alluvial Groundwater Recharge

Alluvial aquifers are recharged by infiltration of stream water during sustained high river stage and flooding, direct precipitation, and underflow from underlying and adjacent bedrock. Groundwater data suggest that recharge may also be occurring from the leachate retention pond south of the active landfill and the Earth City industrial park storm water retention pond west of the site (Burns & McDonnell, 1986) (see Figure 2-5). This will be evaluated as part of this RI/FS investigation.

2.2.3.1.2 Alluvial Groundwater Movement

The overall alluvial groundwater flow direction beneath the site is to the northwest toward the Missouri River. Groundwater movement is affected by regional flow patterns and site-specific conditions. Regional groundwater movement is dependant upon the river stage. Groundwater monitoring wells completed in the alluvial aquifer at shallow (20 to 40 feet), intermediate (31 to 61 feet) and deep (45 to 143 feet) depths indicate that groundwater flow is essentially the same for all three well completion depths (Burns & McDonnell, 1986). The cited alluvial aquifer zone depths (shallow, intermediate, and deep) overlap due to the variable depth of the alluvial aquifer overlying the bedrock valley wall. In the eastern portion of the site, the decreasing depth and thickness of the alluvial aquifer at the alluvial valley wall allow only the shallow portions of the aquifer to be present. In the center of the site, both the shallow and intermediate portions are present, and in the western portion of the site all three portions exist.

The currently active sanitary landfill includes a leachate collection system (Section 2.5.2) which maintains an inflow of bedrock groundwater toward the landfill. The inflow creates a local water table depression around the landfill.

A low (3-foot relief) groundwater mound was identified by Burns & McDonnell (1986) as persistently present in the southern portion of the site, north of Old St. Charles Rock Road. According to Burns & McDonnell (1986), the mound was apparently the result of a local recharge area created by:

- Pumping water from the quarry to surface drainage ditches;
- Surface infiltration along Old St. Charles Rock Road; and,

- Possible leakage from unlined surface water holding ponds in the vicinity of the quarry.

The mound is not present according to McLaren/Hart (1994a) based on selected wells and averaged groundwater levels. The absence of the mound is likely the result of discontinuing the use of surface drainage ditches and unlined surface water holding ponds. Alluvial groundwater flow direction and gradient will be defined as part of this RI/FS.

2.2.3.1.3 Alluvial Groundwater Discharge

There are no indications of natural springs at the site in any previous investigation reports and correspondence.

2.2.3.1.4 Alluvial Groundwater Hydraulic Properties

The hydraulic conductivity of the upper portion of the alluvium, comprised of silts and clays, is estimated at 1×10^{-4} centimeters per second (cm/sec) (Burns & McDonnell, 1986). The lower portion of the alluvium, comprised of heterogenous sands and gravels, has an average hydraulic conductivity value of 7×10^{-2} cm/sec, with a range from 2.4×10^{-4} to 2.5×10^{-1} cm/sec. The estimated average flow rate across the northern and western site boundaries is about 500 gallons per day (gpd) in surficial alluvial materials and 400,000 gpd in deep alluvial materials (Burns & McDonnell, 1986).

2.2.3.1.5 Alluvial Groundwater Quality

Data regarding regional alluvial groundwater quality is sparse. A limited 1966 survey of groundwater resources in the Missouri River alluvium identified alluvial groundwater as predominantly calcium-bicarbonate type with significant amounts of magnesium and sulfate (Emmett and Jeffrey, 1968). The water is typically very hard and has a high iron and variable dissolved solids content.

The average concentration for these constituents are tabulated below.

Constituent	Average Concentration in milligrams per liter (mg/l)
Total Dissolved Solids	530
Calcium	131
Magnesium	36
Iron	3.4
Chloride	3.4
Fluoride	0.2
Nitrate	0
Sodium	9.4
Potassium	5.6
Bicarbonate	542

During the survey, groundwater collected from a well completed in alluvial materials about 2 miles north-northeast of the site (based on water level data available inferred to be cross-gradient of the site) displayed higher than average calcium and chloride/fluoride/nitrate levels, and lower than average magnesium, sodium/potassium, and bicarbonate levels. Total dissolved solids (TDS) for this well was estimated at 510 milligrams per liter (mg/l). A well 2 miles northwest of the site, sampled as part of the Emmett and Jeffrey (1968) investigation, displayed concentrations of these parameters closer to regional characteristics, and 608 mg/l of TDS.

2.2.3.1.6 Alluvial Groundwater Use

Alluvial groundwater wells completed in the Mississippi and Missouri river floodplains are capable of yielding more than 2,000 gallons per minute (gpm) (Emmett and Jeffrey, 1968). However, no public water supply wells within the vicinity draw from the alluvial aquifer (Foth

& Van Dyke, Dec. 12, 1989). The two private groundwater wells within one mile of the site are used for monitoring, or commercial purposes, and not for drinking water (Foth and Van Dyke, Feb. 10, 1994). The private groundwater well located at the Old Bridge Bait Shop is 5,100 feet from the site boundary while the private groundwater "shop well" is located 4,600 feet from the site boundary.

2.2.3.2 Bedrock Aquifers

As identified in Table 2-1, bedrock aquifers in the St. Louis area which are favorable for groundwater development include Ordovician-age St. Peters Sandstone, Roubidoux Formation, Gasconade Dolomite and Cambrian-age Potosi Dolomite (Miller, et al., 1974). The Mississippian-age Meramecian series formations directly underlying the site are not identified as favorable for groundwater development (i.e., yield less than 50 gpm to wells).

Miller, et al., (1974) describes the uppermost regional aquifers (Pennsylvanian, Mississippian, Devonian, and Silurian) as yielding small to moderate quantities of water, ranging from 0 to 50 gpm. The Ordovician-age, Cinncinnatian-series Maquoketa shale underlying these aquifers probably constitutes a confining influence on water movement. Miller therefore identifies the overlying (younger) bedrock aquifers (i.e., Pennsylvanian, Mississippian, Devonian, and Silurian) as the Post-Maquoketa group. Deeper Ordovician-age and Cambrian-age aquifers described below are considered favorable as non-potable water sources.

The St. Peter Sandstone aquifer lies at a depth of approximately 1,450 feet below ground surface and can be as much as 160 feet thick. The average depth of the Roubidoux Formation is approximately 1,930 feet. Thicknesses of this unit in the St. Louis area range from 0 to 177 feet. The Gasconade Dolomite directly underlies the Roubidoux Formation. The Gasconade and associated Gunter Sandstone occur in thicknesses of up to 280 feet. The Potosi Dolomite can be present in thicknesses of up to 325 feet, at an average depth of 2,240 feet. It should be noted that the thickness of and depth to these formations varies throughout the St. Louis area, and they may not be present at all in some places.

Limited groundwater is present within the Post-Maquoketa bedrock which directly underlies the site. Water levels in deep wells at the site which are completed in the upper portion of the limestone bedrock generally have water level elevations which are hydrostatically similar to or slightly lower than adjacent shallow and intermediate depth alluvial monitoring wells (McLaren/Hart, 1994a).

The base of the Salem/St. Louis limestone mined at the site is formed by the relatively impermeable Warsaw Shale, which was reached during quarrying operations. The Warsaw Shale acts as an aquiclude, limiting contact between groundwater in the upper limestone aquifer and deeper water bearing units.

2.2.3.2.1 Bedrock Groundwater Recharge

The deep bedrock aquifers are recharged directly by surface water in areas where the bedrock strata are exposed, through the alluvium in areas where truncated limbs of deformed bedrock are disconformably overlain by alluvial aquifers, or by surface water infiltration from the overlying loess (Miller, et al., 1974). Within the central and northern portions of the site, the groundwater originates from the overlying alluvial aquifer.

2.2.3.2.2 Bedrock Groundwater Movement

Groundwater movement within bedrock aquifers is poorly defined, due to limited data and well completion across several stratigraphic units (Miller, et al., 1974). As described above, productive bedrock aquifers lie beneath the confining Maquoketa Shale; groundwater movement within confined aquifers is from areas of high hydrostatic pressure to areas of low hydrostatic pressure. Some movement of groundwater between aquifers may occur when sufficient permeability exists at the contacts between the units. The work proposed as part of this RI will assist in defining bedrock groundwater movement.

The site leachate collection system, described in Section 2.5.2, pumps approximately 340,000 gallons per day, inducing bedrock groundwater flow towards the collection system. This inward gradient is locally towards the former quarry pit.

2.2.3.2.3 Bedrock Groundwater Discharge

Discharge from bedrock aquifers near the site is similarly difficult to define. An undetermined amount of discharge from deeper aquifers into shallow aquifers is taking place in the area (Miller, et al., 1974). Discharge from bedrock aquifers to alluvial aquifers is anticipated to be minimal, based on the permeability of the respective units.

Seeps have been locally observed on the limestone quarry walls. During quarrying operations, seepage into the northernmost pit was calculated at approximately 35 gallons per minute (Reitz & Jens, Feb. 4, 1981). This water was collected and pumped from the pit during quarrying and landfilling activities.

The existing leachate collection system in the active solid waste landfill is designed to induce inward flow of groundwater to the pit. Groundwater flow into the quarry was estimated at 43,000 gpd in 1986; the current volume pumped from the pit via the leachate collection system is about 340,000 gpd.

2.2.3.2.4 Bedrock Hydraulic Properties

The hydraulic conductivity of the limestone bedrock is likely to be several orders of magnitude lower than that of the alluvium. Groundwater flow within the limestone is essentially limited to fractures and along bedding planes based on observations of the exposed limestone of the quarry walls. Bedrock hydraulic properties will be characterized as part of the OU-2 RI.

2.2.3.2.5 Bedrock Groundwater Quality

Limited data about regional bedrock groundwater quality is available. According to Miller, et al., (1974), water of the Post-Maquoketa aquifer group varies from a calcium-magnesium-bicarbonate type to a sodium-sulfate, sodium-bicarbonate, or a sodium-chloride type. Total dissolved solids (TDS) content varies from 246 to 6,880 mg/l. The water is generally low in iron (less than 0.3 mg/l) and very hard (greater than 180 mg/l). Fluoride content is also relatively high, averaging over 1.4 mg/l. Potable water was yielded by over 50 percent of the wells completed in or near the outcrop line of the Meramecian-series rocks, but high TDS, sodium, and chloride concentrations were observed in wells completed in these formations near the site.

2.2.3.2.6 Bedrock Groundwater Use

Wells yielding up to about 50 gpm can be developed in bedrock aquifers immediately underlying the site (Miller, et al., 1974). Deeper wells, completed in aquifers about 1,500 feet below ground surface, are capable of producing up to 300 gpm.

In 1989, 26 private water supply wells were identified within a 3-mile radius of the site; no well within a 1-mile radius is used as a drinking water source. The number of private water supply wells has likely decreased since 1989 due to development and a flood in 1993. The closest well used for a drinking water source is located approximately 5,500 feet north of the site (Foth & Van Dyke, Feb. 10, 1994).

2.2.4 Hydrology

2.2.4.1 Regional Hydrology

Three major rivers, the Mississippi, the Missouri, and the Meramec, pass through the St. Louis area and supply nearly all of the water used in the St. Louis area (Emmett and Jeffrey, 1968).

The Mississippi River flows along the eastern state border. The Missouri River flows through the western and northern portions of the St. Louis metropolitan area and discharges into the Mississippi north of St. Louis. The Meramec flows along the southern portion of the metropolitan area and discharges into the Mississippi south of St. Louis. Other minor rivers and streams in the area are tributaries to these three rivers. In addition, a few minor surface water features (lakes) exist in the region. The rivers and tributaries drain the surface run-off from the region.

Precipitation that falls onto the historic Missouri River floodplain generally infiltrates rather than running off the surface. The Missouri River floodplain is relatively flat and sediments have an infiltration index of 3.5 inches (Miller, et al., 1974). Streams present within the floodplain are those that originate in the surrounding uplands.

Drainage patterns within the historic floodplain surrounding the site have been altered by flood control measures taken to protect the nearby commercial development and by the drainage of local swamps and marshes. Before these alterations, Creve Coeur Creek passed just south of the site, along Old St. Charles Rock Road. The creek has since been redirected to discharge to the Missouri River upstream of St. Charles. The old channel still carries some water (see Figure 2-2), although near the site the channel is usually dry (Banerji, et al., 1984). A stormwater retention pond encompassing a portion of the old Creve Coeur Creek channel is present west of the site, adjacent to the Earth City industrial park.

The present channel of the Missouri River lies about 1.5 miles west and northwest of the site. Historic land surveys indicate that 200 years ago the channel was several hundred yards east of its present course (Banerji, et al., 1984). The Missouri River has a surface slope of 0.00018 feet/foot. The reference river stage at St. Charles (west of the site) (Mile 28) is 413.7 feet MSL. Average discharge for the Missouri River is 77,300 cubic feet per second (cfs), with a typical minimum flow of 40,300 cfs in December and January.

2.2.4.2 Local Hydrology

Historic aerial photographs from 1941 through 1991 were reviewed by the EPA (1989 and 1991a) and show several surface water features present on the property. Two ponds, located within areas subsequently mined, are visible in 1941 aerial photographs (see Section 2.4.1). Surface water drainage channels present onsite prior to development were oriented in a north to northeasterly direction and were directed towards a slough at the northern extreme of the site, along St. Charles Rock Road.

Quarry and landfill operations have influenced surface water runoff patterns and led to localized ponding of rainwater. Some of these ponds are associated with site quarrying and landfilling operations; however, these ponds are apparently not associated with natural surface water accumulation. The EPA review indicates that three ponds associated with quarrying operations were present near the central portion of the site continuously from 1941 until 1989 (quarrying operations ceased in 1988). Three leachate treatment lagoons and a retention pond are also visible, beginning in 1985.

As depicted in Figures 2-8 and 2-9, the EPA has determined that potential liquid waste and sludge disposal sites were present at various locations near the northern extent of the inactive landfill area (southern extent of OU-1 Area 2) from 1958 until 1971.

Stormwater runoff and groundwater seepage contributed to ponding within the quarry pits. The quarry ponds varied in location and size according to year, season, and development of quarrying or landfilling operations.

Currently, surface water bodies are limited to the leachate retention pond located south of Old St. Charles Rock Road, the slough north of the site, and surface water runoff accumulated in depressions of the current landfill. Based on current topography, drainage from the central portion of the site is directed south towards the former quarry (Figure 2-10). Drainage along the perimeter of the property is directed away from the site towards the perimeter property lines. The slough at the northern extreme of the site is intermittently present.

Two National Pollutant Discharge Elimination System (NPDES) permits are in place for the facility (Midwest Environmental, 1994). Permit No. MO-0112771 includes outfalls for three points, located north of the site office near the demolition landfill, northeast of OU-1 Area 1 along St. Charles Rock Road, and west of the quarry operations portion of the site (not currently monitored). Permit No. MO-R101881 includes two outfalls, one located south of the leachate retention pond not currently monitored, and one located north of the leachate retention pond. NPDES-permitted outfalls are depicted in Figure 2-11.

2.2.4.3 Surface Water Use

The City of St. Charles draws water from the Missouri River at an intake located on the north bank near River Mile 29, approximately 1 mile upstream of the site. The St. Louis County, North County plant draws water from an intake located at River Mile 20.5, approximately 7.5 miles downstream of the site. No other surface water usage has been identified.

A wetlands inventory map prepared by the US Department of Interior, Fish and Wildlife Service for the site vicinity is provided in Figure 2-12. The map identifies four man-made leachate retention ponds. Site surface water bodies are described as palustrine, unconsolidated bottom, intermittently exposed, excavated features. The Fish and Wildlife Service survey identified wetlands based on stereoscopic analysis of aerial photographs, without field verification.

2.2.5 Chemical Occurrence

Environmental monitoring at the site and vicinity for site characterization and regulatory compliance has been conducted for the operator and regulatory agencies to identify the presence or absence of chemicals in soil and sediment, surface water and groundwater, leachate, vegetation, and air. Analyte lists for these monitoring events were developed based on chemicals reasonably anticipated to be associated with landfilling activities. Additionally, monitoring for radionuclides in each of these media has been conducted, based on the reported 1973 deposition of radiological materials on portions of the site. This section summarizes previous investigations and historical environmental monitoring analyte lists for each media.

2.2.5.1 Previous Investigations

Numerous investigations pertaining to environmental conditions have been conducted at and around the site. Many of these investigations have focused on environmental conditions originating from OU-1; however, these investigations include information pertinent to characterization of OU-2. Additionally, ongoing environmental monitoring of air, soil, surface water, and groundwater has been conducted. A chronological listing and brief summary of each previous investigation is provided below; refer to Figure 2-5 for locations referenced. The RI will include a detailed evaluation of previous investigation results; a preliminary evaluation of investigation results is provided in Section 3.1. A brief chronological summary is provided in Table 2-2.

Groundwater investigations were conducted at the West Lake Landfill site for the site owner/operator in 1973, 1976, and 1979 through 1984. These investigations included sampling and analysis of groundwater in wells around the perimeter of the currently-inactive landfill area (Figure 2-5). Samples were typically analyzed for general inorganic parameters, ions, and metals. Parameter lists occasionally included radionuclides and pesticides, and sampling was expanded to include wells near the synthetically-lined leachate retention pond beginning in 1981. Results of the investigation will be evaluated as part of the RI.

The MDNR conducted a periodic groundwater investigation from 1979 through 1982, including wells and parameters similar to the owner/operator investigations, but expanding the sampling to include surface water bodies at and near the site. Results of these investigations will be evaluated as part of the RI.

Several investigations were also conducted between 1982 and 1988 by and for the Nuclear Regulatory Commission, primarily to assess the potential for radiological contamination in the OU-1 areas. The investigations included surficial soil sampling and analysis, groundwater sampling and analysis, and perimeter berm erosion analysis. A related evaluation of remedial action alternatives for the OU-1 areas was conducted in 1983 by the College of Engineering, University of Missouri-Columbia. This investigation concluded that there was no indication of radioactive contamination moving off-site, but that erosion of the perimeter berm potentially allowed off-site migration, and that radon gas generation was likely to increase. Analytical results of groundwater sampling and analysis for radionuclides will be evaluated as part of the OU-1 RI/FS.

A complete hydrogeologic investigation of the inactive landfill portion of the site was conducted for West Lake Landfill by Burns & McDonnell in 1986. Existing and new wells were sampled in two rounds, beginning in 1985 (Burns & McDonnell, 1986). Samples were analyzed for volatile organic compounds, acid/base neutral extractables, pesticides/polychlorinated biphenyls (PCBs), phenol, cyanide, and metals. Selected wells were analyzed for radionuclides in the first round. The *Hydrogeologic Investigation, Primary Phase Report, West Lake Landfill* presented the following conclusions:

- Trace amounts (i.e., less than 0.0007 mg/l) of several pesticides were detected; however, their presence was questionable because they were only detected in one of the two sampling rounds;
- Even at very low detection limits (i.e., 0.001 to 0.004 mg/l), few heavy metals were detected. The distribution of dissolved metals showed no distinct pattern and downgradient levels did not significantly differ from upgradient levels. The highest lead concentration was found in a background well. Zinc was determined to be naturally occurring;
- The data did not show a distinct difference in water quality between shallow and deep portions of the alluvial aquifer; and,
- Several detected compounds were also present in associated blank samples, suggesting laboratory contamination.

In 1989 and 1991, the EPA reviewed historical aerial photographs of site from 1941 to 1991. The *Aerial Photographic Analysis of the West Lake Landfill Site, Bridgeton, Missouri* identified areas of mining and waste disposal activities (EPA, 1989 and 1991a).

In 1989, Laidlaw Waste Systems (Bridgeton), Inc. began an ongoing groundwater investigation as part of routine sampling. These analytical results will be evaluated as part of the RI.

Samples from wells immediately east of the active landfill were collected and analyzed in 1989 for general inorganic parameters and metals (Environmental Analysis, July 14, 1989). The investigation was expanded to 21 wells for one sampling event conducted in 1990. Samples were collected and analyzed for general inorganic parameters, metals, radionuclides, volatile organic compounds, pesticides, herbicides, PCBs, cyanide, and phenol (Environmental Analysis, Oct. 4, 1990, Oct. 10, 1990, Nov. 1, 1990, and Dec. 1, 1990; York, Oct. 4, 1990). From 1991 through 1993, wells around the perimeter of the active landfill were sampled. Samples collected from these wells were analyzed for general inorganic parameters and iron (Environmental Analysis, Dec. 18, 1991; Laidlaw, Dec. 29, 1992, and Mar. 30, 1993; Environmental Analysis, July 7, 1993, Sept. 10, 1993, and Dec. 20, 1993). A sampling event conducted in May 1993 included an extended metals parameter list, pesticides, and herbicides.

From 1990 to 1993, investigations conducted at the adjacent Earth City industrial park identified two radiological "hot spots" adjacent to the West Lake Landfill. A follow-up gamma survey and soil, sediment, and groundwater sampling investigation generally did not identify radiological, inorganic, or organic chemical contamination for the site above background levels (Dames & Moore, 1990b). However, biased soil samples collected from the two previously-identified "hot spots" identified radionuclide concentrations up to three times above background levels as defined by their study. A remedial action investigation for the industrial park identified 4,600 cubic feet of radiologically-contaminated soils and recommended restricting these areas from public access (Dames & Moore, 1991). A 1993 study of previous hydrogeologic investigations and groundwater level data for Earth City industrial park concluded that the adjacent landfill had not contaminated groundwater beneath Earth City, nor was such contamination likely to occur, based on groundwater flow regimes and the presence of a canal (former Creve Coeur Creek channel) along Old St. Charles Rock Road (Midwest Testing, 1993).

In 1991, a risk assessment was conducted by the Agency for Toxic Substances and Disease Registry (ATSDR), US Department of Health and Human Services. The *Preliminary Health Assessment for West Lake Landfill, Bridgeton, St. Louis County, Missouri* determined that the site presents no apparent public health hazard, although exposure could occur if groundwater contamination increases and spreads, exposed radioactive materials move off-site, or on-site worker exposure increases (ATSDR, 1991).

A draft report was written describing a soil vapor survey conducted in 1991 to investigate the extent of hydrocarbon impacts in the vicinity of MW-F2 (Figure 2-5). As depicted in Figure 2-13, the survey identified benzene, toluene, ethylbenzene, xylene (BTEX), and total petroleum hydrocarbons (TPH) in soils, extending up to 150 feet north and 300 feet south of MW-F2 (Terracon, Jan. 13, 1992). The maximum values for these constituents was observed in the 15- to 18-foot interval in a borehole installed adjacent to MW-F2. For example, TPH was measured at 3,548 μg/L at this location.

In 1992, a series of evaluations of the impact of radioactive and other special waste materials on then-current landfilling operations found radon gas in the landfill gas collection system, and concluded that migration of radioactive material into the active landfill from OU-1 Area 1 may have occurred (Wester, 1992a and 1992b).

The berm along the western portion of the inactive landfill adjacent to Old St. Charles Rock Road was upgraded in 1992. The upgrades included flattening of the slope to a general 3 horizontal to 1 vertical, placement of soil cover, and slope revegetation (J&L Engineering, 1992).

In 1993, an assessment of surficial radiological contamination in landfill gas collection and leachate collection systems concluded that exposure to radiological contaminants from these sources was not a threat to site workers, the general public, or the environment. In 1994, chemical constituents in landfill gas were measured at two gas collection system locations, and exposures to 11 site workers were measured via personal dosimetry. Results indicated that the composition of the landfill gases was similar to EPA-reported average landfill gases. Personal ambient air samples were analyzed for volatile organic compounds and fixed gases. Results for all analyte were below detection limits.

An investigation into the extent of a landfill fire in the quarry central pit (former Black Diamond Lake location) was also conducted in 1994. Infrared thermography identified a subsurface landfill fire adjacent to the north wall of the central pit (SCS Engineers, May 17, 1994). A concrete slurry was injected into the landfill cover around and over the landfill fire area to suffocate the fire.

McLaren/Hart conducted an overland gamma survey of OU-1 and the immediate vicinity in late 1994 (McLaren/Hart, 1994b). The survey identified slightly elevated gamma radiation extending west of OU-1 Area 1 to the site access road, and southwest of OU-1 Area 2 onto neighboring property, although all results were below health-based action levels. For completeness, McLaren/Hart recommended expansion of the OU-1 Area 1 investigation to include the outlying radiological hot spot.

2.2.6 Meteorological Conditions

2.2.6.1 Wind

Wind direction during the period of December through April at Lambert/St. Louis International Airport, approximately 4 miles east of the site, is generally from the northwest and west-northwest. According to the National Oceanic and Atmospheric Administration (NOAA), wind direction throughout the remainder of the year is primarily from the south. Differences in the topography between the airport and the site may result in the actual wind direction at the site being slightly skewed in a northeast-southwest direction parallel to the Missouri River valley (Banerji, et al., 1984).

2.2.6.2 Temperature

The climate at the site is typical of the midwestern United States. This areas has a somewhat modified continental climate with four distinct seasons (Banerji, et al., 1984). Winters are generally not severe with the first frost usually occurring in October and freezing temperatures generally not persisting past March. Records since 1870 show that temperatures drop to zero (0°F) or below an average of two or three days per year. Temperatures remain at or below freezing (32°F) less than 25 days in most years.

Summers in the St. Louis area are hot and humid. The long term record (since 1870) indicates that temperatures of 90°F and higher occur on about 35 to 40 days per year, and that extremely hot days of 100°F and higher generally occur no more than five days per year.

2.2.6.3 Precipitation

Normal annual precipitation is a little less than 34 inches, based on records since 1871 (Banerji, et al., 1984). The winter months are usually the driest, with an average total of approximately 6 inches of precipitation. Average snowfall during the winter is slightly greater than 18 inches. Snowfall of an inch or more is received on five to ten days in most years. Record snowfall accumulation over the past 30 years was 66.0 inches during the winter of 1977-78. The spring months are the wettest with normal total precipitation of just under 10.5 inches. Thunderstorms occur normally on 40 to 50 days of the year. Usually a few of these storms each year can be classified as severe with hail and damaging wind. Tornadoes have occurred in the St. Louis area. Average humidity is 68 percent with humidity over 80 percent reported during the summer months.

2.2.7 Ecology

According to the NRC (1988), several ecological systems exist at the site. A series of small habitats are associated with:

- Moist bottomland and farmland adjacent to the perimeter berm;
- Poor quality drier soils on the upper exterior and interior slopes of the berm;
- An irregular ground surface associated with the inactive portion of the landfill; and,
- Aquatic ecosystems present in low spots on the ground surface and adjacent surface water.

The natural systems present are influenced by operations at the site, and are common to similar areas in east-central Missouri. These systems are located in a corridor along the perimeter berm (Figure 2-5), from near well S-75, along Old St. Charles Rock Road, clockwise to the main entrance of the landfill, to near well S-68, along St. Charles Rock Road. The following observations and descriptions about flora and fauna have been summarized from NRC (1988).

2.2.7.1 Sensitive Environments and Critical Habitats

No information about sensitive environments or critical habitats was identified in previous reports.

2.2.7.2 Flora

According to the NRC (1988), the flora along the bottom and lower slope of the berm along St. Charles Rock Road (Figure 2-5) includes silver maple (Acer saccharinum), boxelder (Acer negundo), oak (Quercus spp.), sycamore (Platanus spp.), green ash (Fraxinus pennsylvanica) and eastern cottonwood (Populus deltoides) trees. At the north corner of the site, large silver maple and boxelder trees form a dense stand in the moist soils at the base of the berm. The density of these trees declines on this slope extending towards the north. The extension of this slope towards the northwest is dominated by a dense willow-like thicket in which eastern cottonwoods and a hawthorn tree have been established. From the northwest corner of the landfill to the east, along St. Charles Rock Road, the exterior slope of the berm in dominated by dense stands of small and large eastern cottonwoods. The ground cover along these exterior slopes consists of grasses, forbs, plants common to disturbed areas, seedling cottonwoods, and shrubs.

The somewhat drier top and the short interior slope of the perimeter berm include prairie grasses such as bluestem (Andropogon spp.). Depressions in the irregular surface of the inactive unregulated landfill allow water to collect and tall grasses, foxtail, and plants characteristic of disturbed areas [e.g., ragweed (Ambrosia spp.), mullein (Verbascum spp.), pokeweed (Phytolacca spp.), cinquefoil (Potentilla spp.), sunflower (Helianthus spp.), and plantain (Plantago spp.)] are replaced by characteristic wetland species [e.g., algae (Spirogyra spp.), cattails (Typha spp.), sedges (Carex spp.), and smartweed (Polygonium spp.)]. Young eastern cottonwoods are established at several of these depressions.

The ground is largely barren near the demolition landfill and the areas associated with recent sanitary landfilling activities.

2.2.7.3 Fauna

The NRC (1988) encountered cottontail rabbits (Sylvilagus spp.) at the site. Coyote (Canis latrans) feces containing rabbit fur were also observed. Small mammals (rodents) were not seen but may be present in this area. No large ungulates were sighted, but tracks and feces of white-tailed deer have been observed.

Few birds were observed early in the spring: a crow (Corvus), several robins (Turdus spp.), and white crowned sparrows (Zonotrichia leucophrys). This does not reflect the extent to which birds utilize the habitat throughout the year. Some migratory passerines may use the surface vegetation and berm thickets for nesting, cover, and feed later in the season. Waterfowl may use the permanent ponds on the landfill and adjacent to St. Charles Rock Road. Scaup (Aythya spp.) and mallards (Anas spp.) were observed on the leachate retention pond.

Small puddles contained characteristic common aquatic invertebrate and at least two species of amphibians. Snails, an isopod (Asnellus), cyclopoid copepods, and cladocerans were observed in these small puddles. Aquatic insect larvae were not observed. A bullfrog tadpole (Rana catesbeiana) and audition of spring peepers (Hyla spp.) were observed. No fish were observed in puddles on the site, although fishing tackle was found tangled in power lines and trees, indicating that fish may be present. The only reptiles observed were the water snake (Nerodia spp.) and garter snake (Thamnophis spp.).

According to McLaren/Hart (1994a), the Missouri Department of Conservation (MDOC) reports 25 amphibian, 47 reptilian, 29 mammalian, and 299 avian species in the regional area of St. Charles County. Many of the terrestrial vertebrates found within this area are widely distributed species. The MDOC has recorded more than 105 species of fish in the regional area, although none appear to exist near the site.

2.3 Demographics

The West Lake Landfill is located in the northwestern portion of the City of Bridgeton, in St Louis County, Missouri (Figure 2-2). The Earth City industrial park is located on the floodplain of the Missouri River, 0.9 to 1.2 miles west of the active sanitary landfill. Population density on the floodplain is generally less than 26 persons per square mile; the daytime population, including factory workers, is much greater than the number of full-time residents (ATSDR, 1991).

Major highways in the area include Interstate 70 (I-70) and Interstate 270 (I-270), which intersect southeast of the landfill (Figure 2-1). The Earth City Expressway and St. Charles Rock Road lie, respectively, west and northeast of the landfill. The Lambert/St. Louis International Airport is about 4 miles east of the site.

Industrial plants operated by Purina Mills, Inc. (PMI) and Hussman Refrigeration are located north of the site, across St. Charles Rock Road. The employees of these plants comprise the largest group of individuals in close proximity to the site. Land in this area is relatively inexpensive and much of it is zoned for manufacturing so it is likely that there will be further industrial development in the future.

Two small residential communities are present near the West Lake Landfill (Figure 2-2). Spanish Lake Village consists of about 90 homes and is located 1.5 km (0.9 miles) south of the landfill. A small trailer court lies across St. Charles Rock Road, 1.5 km (0.9 miles) northeast of the site. Subdivisions are presently being developed 2 to 3 km (1.2 to 1.9 miles) east and southeast of the landfill in the hills above the floodplain. Ten or more houses lie northeast of the landfill along Taussig Road, north of St. Charles Rock Road. The City of St. Charles is located north of the Missouri River at a distance greater than 3 km (1.9 miles) from the landfill.

2.3.1 Population

The population of the City of Bridgeton, according to the 1990 US Census, is 17,779 (US Dept of Commerce, 1994). St. Charles, located across the Missouri River (Figure 2-1), has a population of 54,555, and exhibited a growth of approximately 45 percent from 1980. The City and County of St. Louis decreased in population by nearly 9 percent from 1980 to 1990.

2.3.2 Land Use

Figure 2-3 depicts zoning designations at and around the site (City of Bridgeton, 1982). The majority of the site is designated M-1, "Limited Manufacturing District," or M-3, "Planned

Manufacturing District: West Lake Quarry Tract." Existing industrial operations are generally nonconforming use with current zoning, but have been grandfathered based on pre-existing use. The northern portion of the property, including the demolition landfill and OU-1 Area 2, extends into residential zone R-1, "One-Family Dwelling District." A State of Missouri Court of Appeals Eastern District, Division Two decision (West Lake Quarry and Material Company v. City of Bridgeton, et al.) No. 54007, dated December 6, 1988, held that residential zoning near the site is unconstitutional. Surrounding areas vary in designated usage, including manufacturing and business districts. Additionally, State of Missouri and Federal RCRA Subtitle D Regulations restrict the use of land that is the site of a closed municipal solid waste landfill (MSWLF) unit.

2.3.3 Cultural and Historical Resources

No information regarding cultural or historical resources associated with the site was identified in reviewed literature. The RI will include an investigation of these potential resources.

2.4 Historical Site Operations

2.4.1 Quarrying

Quarrying operations were initiated at the central portion of the site in 1939 (Figure 2-14). On-site processing was also conducted. Mine spoils were deposited on the alluvial materials west of the quarry pits and process areas. Quarrying operations were extended to the south pit by 1953 and to the north pit by 1965 (EPA, 1989d). A pond identified by the EPA (1989d) in a 1941 aerial photograph was located west of Taussig Road. This pond was apparently eliminated during mining operations in the north pit.

Beginning in 1980, the central pit area was used to hold water flowing into the north pit from surface water runoff and pit wall seepage, indicating that mining was no longer taking place in the central pit. The central pit was known as Black Diamond Lake while used as a collection pond for pumped water. Although a specific date for cessation of quarrying in the north pit has not been identified, waste disposal within the north pit area was permitted in 1979, indicating that mining was no longer taking place at this location. Quarrying operations in the south pit ceased in 1987 when economically-recoverable reserves were exhausted (McLaren/Hart, 1994a).

2.4.2 Asphalt and Concrete Batch Plants

Historical aerial photographs indicate that crushing and processing facilities associated with the quarry were present on-site as early as 1941 (EPA, 1989d), and likely were constructed when quarry operations began in 1939. The crusher was reportedly abandoned in 1988 when quarry operations ceased. The crusher building is still present at its original location (Figure 2-5). The Memorandum of Agreement licensing certain activities allows Laidlaw to remove part or all of the abandoned crusher and bins (West Lake Quarry and Material Company, June 16, 1964).

Asphalt batch and concrete processing facilities currently occupy the quarry operations area near the abandoned crusher. Maryon Industries, Inc. (Maryon) and Red Bird Pre-Mix Co. (Red Bird) are tenants of this area. According to the Memorandum of Agreement (West Lake Quarry and Material Company, Nov. 16, 1993), the primary rights of these tenants are:

- Maryon:
  - Premises easement
  - Road easement
  - Lagoon system easement
  - Licenses for:
    - One shop bay
    - Storage area (shared with Red Bird)
    - Lube bay (shared with Red Bird)
    - Change house (shared with Red Bird)
    - Laboratory (shared with Red Bird)
    - Dispatcher's office
- Red Bird:
  - Easement agreement

- One shop bay
- Storage area (shared with Maryon)
- Lube bay (shared with Maryon)
- Parking area
- Offices
- Change house (shared with Maryon)
- Ground-level concrete slab

The rights of Red Bird also include available real estate to dump waste concrete, in accordance with any applicable laws or regulations.

2.4.3 Landfilling

2.4.3.1 Pre-MDNR Waste Disposal

Before 1974 waste disposal at the site was regulated solely by St. Louis County authorities. In April 1952 a permit authorizing the disposal of combustible waste was granted by the Office of Zoning Enforcement of St. Louis County (Midwest Environmental, 1994), indicating that waste disposal may have initiated at this time. West Lake Landfill, Inc. became a separate entity from West Lake Quarry on February 16, 1962. Most sources cite 1962 as the initiation of waste disposal at the site.

The pre-MDNR waste disposal at the site reportedly consists of:

- Sanitary wastes;
- Mixed wastes; and,
- Demolition wastes.

Pre-MDNR waste disposal sites are depicted in Figure 2-15. Wastes were reportedly deposited directly on the ground surface with no excavation or cover (Banerji, et al., 1984).

An air curtain destructor previously was used near the inactive landfill (Figure 2-5). The types of wastes burned in the destructor include land clearing debris and other wood wastes. The destructor was used on an intermittent basis until approximately 1992.

Available information indicates that industrial wastes were deposited at the site by several companies between 1969 and 1979 (Reitz & Jens, Sep. 9, 1983). The exact disposal location of these wastes is not known; however, permitted sanitary waste disposal was allowed in the 118903 and 118906 areas between 1976 and 1978, indicating that these industrial wastes were possibly disposed either before MDNR permitting or in other areas. This information is supported by EPA Form D, "Supplemental Hauler Information" data, as summarized below:

- Borden Chemical Company, Printing Ink Division, disposed an unknown quantity of paints and pigments between 1974 and 1979;
- Chevron Chemical Company, Ortho Agricultural Division, disposed 4,000 tons of insecticides, herbicides, fungicides, intermediates, and nonpolar solvents at the site between 1969 and 1979; and,
- Olin Corporation, Winchester-Western Division, discarded 1,100 tons of insecticides and shock sensitive wastes at the site between 1974 and 1979.

Finally, Pfizer, Inc. disposed 2,100 tons of unspecified heavy metals and inorganic wastes between 1978 and 1979 (Reitz & Jens, Sep. 9, 1983).

Industrial wastes were apparently disposed of prior to the effective date of the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations (November 19, 1980), and are therefore not subject to management as hazardous wastes under RCRA.

Site ownership as of 1973, immediately prior to MDNR regulation of solid waste disposal, is depicted in Figure 2-16.

2.4.3.2 MDNR-Regulated Waste Disposal

In 1974 the site came under State regulatory authority when the Missouri Department of Natural Resources (MDNR) was formed (Midwest Environmental, 1994). The MDNR identified six pre-MDNR waste disposal areas at the site (Figure 2-15) (not to be confused with OU-1 Areas 1 and 2). The MDNR permitted disposal of demolition waste in areas 1, 3, 5, and 6 after a 24-inch clay cap was placed over the existing waste. The MDNR closed areas 2 and 4 (i.e., did not permit additional waste disposal at these areas).

The following paragraphs describe site development for sanitary and demolition landfilling. A summary of landfilling permits is provided in Table 2-3 and depicted in Figure 2-4. It should be noted that MDNR-regulated waste disposal often occurred on top of the pre-MDNR waste disposal sites. Figure 2-17 depicts the conceptual waste disposal sequence within the inactive waste disposal area.

The Permit No. 118903 sanitary landfill area is a 25-acre tract located on top of the mine spoils deposit area on the western portion of the site. This area was expanded by the addition of an adjacent 3.5-acre tract in 1978. Sanitary waste disposal in the 13-acre north quarry pit was authorized by Permit No. 118906 in 1979. This area was nearing capacity by April 1980 (Reitz & Jens, April 1980), and additional expansion in the mine spoils area was authorized by Permit No. 118908 in August 1980 (Midwest Environmental, 1994). Vertical expansion of the Permit No. 118906 area, and adjacent 3 acres in the former central quarry pit, was requested in June 1981 (Reitz & Jens, June 26, 1981) and permitted on August 20, 1981 (Midwest Environmental, 1994). Landfilling expanded into the south quarry pit upon issuance of Permit No. 118912 on November 18, 1981 (Midwest Environmental, 1994). The current 52-acre sanitary landfill accepts waste under Permit No. 118912, which includes the south quarry pit as well as permit area 118909 and most of permit area 118906.

The Permit No. 218903 demolition landfill area includes areas 1, 3, 5, and 6 of the unregulated landfill. Application for demolition landfill expansion was investigated in 1982 (Reitz & Jens, Sep. 20, 1982), and included a 45-acre tract encompassing the 218903 areas 1 and 5 as well as the majority of the currently-designated OU-1 Area 2. This application was denied by the MDNR, based on potential remediation of OU-1 Area 2 by the NRC. The proposed demolition landfill expansion was reduced to 30 acres by excluding the OU-1 Area 2 portion (Reitz & Jens, June 21, 1983). This application was also denied, most likely due to further definition of radiologically-contaminated areas in OU-1 Area 2. The final proposed expansion, comprising 22 acres, was submitted in August 1984 and approved on September 19, 1984 (Midwest Environmental, 1994). The current demolition landfill accepts waste under Permit No. 218912, which encompasses the majority of permit area 218903 area 1, and areas in the immediate vicinity.

In 1988 Laidlaw Waste Services, Inc. purchased landfilling operations and associated properties from West Lake Landfill Inc., Sanitary Landfill. Current site ownership is depicted in Figure 2-18 (Midwest Environmental, 1994). Laidlaw is licensed to use certain other portions of the site from West Lake Quarry and Material Company to allow access and support activities for landfill operations (Figure 2-19).

2.4.4 Underground Storage Tanks

No information about site underground storage tanks (USTs) was identified during a literature review. However, physical observations suggest that USTs were formerly used at the asphalt plant. Recently, drilling operations were observed near the asphalt plant UST site (Figure 2-5). An additional UST is present near the site office; this tank is reportedly empty. The RI will include research into potential UST or leaking UST sites.

2.5 Current Operations

2.5.1 Landfill

Approximately 52 acres are currently landfilled with sanitary wastes under Permit No. 118912; Permit No. 218912 allows demolition waste landfilling on 22 acres. The following types of wastes are accepted: municipal solid waste, bulky waste, dead animals, incinerator residue, demolition and construction waste, and brush and untreated wood waste (Midwest Environmental, 1994). The landfill is projected to reach capacity in June 2003 (Laidlaw, Dec. 20, 1994).

2.5.2 Leachate Collection System

A pumping system installed at the site was originally used to dewater quarry pits and collect leachate from landfilled areas (Figure 2-20). The system has been modified to collect leachate from the currently active landfill area only (south quarry pit). In the late 1970s and early 1980s the system consisted of five wells. Well A (later designated Q69) was a pit dewatering well located in the north quarry pit. Well B (later designated K128) was a leachate collection well located near the eastern extent of the 118903 permit area. Wells C and D were also leachate collection wells, located near the western extent of the 118903 permit area. The 118903 area Wells C and D were abandoned at an unknown date; a dewatering well for the Black Diamond Lake pit was subsequently designated Well D (later Q71). A replacement well for the Black Diamond Lake pit Well D was designated Well E (later Q70). The following paragraphs describe leachate collection provided by these wells, as well as the current leachate collection system.

Leachate generated by the inactive landfill (118903 and 118908 permit areas, Figure 2-4) was collected at Well B and pumped for offsite disposal as early as 1978 (West Lake Quarry & Material Co., Jan. 11, 1979). Well B collected and discharged leachate to an adjacent 9,000-gallon tank. The collected leachate was transported to the Metropolitan St. Louis Sewer District

(MSD) Bissell Point Plant for disposal. Prior to collection for off-site disposal, leachate was apparently pumped around the old landfill (permit area 118903) to a drainage ditch leading to Earth City or to an emergency lagoon south of Old St. Charles Rock Road (Reitz & Jens, July 27, 1979). This lagoon is not apparent in aerial photographs reviewed by the EPA, but one site map includes an undated handwritten notation of "emergency lagoon" northwest of the current leachate retention pond (Elbring, 1973). The approximate location of the emergency lagoon is depicted in Figure 2-20. There is no supportive data to indicate this emergency lagoon has ever been utilized.

In July 1979 an on-site leachate treatment system was designed. Pumped leachate was routed through a clarifier with lime admixture to precipitate metals. The effluent then flowed to an aerated pond for three days of biological treatment, followed by one day retention in one of two settling ponds (Environment Energy Consultants, Dec. 17, 1979). The effluent was designed to be discharged at a rate of 38,400 gallons per day (gpd) directly to an MSD lift station located along Old St. Charles Rock Road (Reitz & Jens, May 8, 1980). The treatment system was constructed as designed in the 118903 permit area in the summer of 1980, and first discharged effluent to the MSD sewer on November 21, 1980 (Reitz & Jens, Nov. 24, 1980).

Two additional leachate collection wells, C and D, were located in the 118903 expansion area. Based on historical leachate level data (Reitz & Jens, Apr. 14, 1982), Well C was likely installed in 1979 and Well D apparently was installed in 1981. Available information does not indicate when or if these wells were connected to the leachate treatment system.

By early 1981, expansion of landfilling operations from the north quarry pit (Permit No. 118906) into the Black Diamond Lake area (see Figure 2-14) was being considered. Black Diamond Lake contained water collected from the north quarry pit and surface water runoff, and had an estimated volume of 29,300,000 gallons in January 1981 (Reitz & Jens, Apr. 13, 1981). The MDNR required removal of the water prior to landfill expansion plan approval. A collection well (Well D, later designated Q71) was installed in the lake and a 5-acre, 20-foot deep, polyvinyl chloride-lined leachate retention pond was constructed on the south side of Old

St. Charles Rock Road in the summer of 1981 (Reitz & Jens, June 15, 1981). Water collected from Black Diamond Lake was pumped to the retention pond and then routed through the leachate treatment system. Both the treatment system and the MSD lift station pump were upgraded to handle the additional volume provided by the Black Diamond Lake dewatering project. Permit No. 118909, allowing waste placement in the former Black Diamond Lake pit. was issued on August 20, 1981 (Midwest Environmental, 1994).

In 1984 plans were made to expand landfilling operations into the south quarry pit (see Figure 2-14). A condition of Permit No. 118912 was the installation of three leachate collection sumps: LCS-1, LCS-2, and LCS-3 (Midwest Environmental, 1994). Permit No. 118912 was issued on November 18, 1985. One additional leachate collection sump (LCS-4) was added on July 13, 1990.

The current system consists of these four leachate collection sumps (LCS-1, LCS-2, LCS-3, and LCS-4) and leachate collection well K128 (formerly Well B) (Stock, 1993). The system recovers approximately 340,000 gpd. Leachate is pumped to the 5-acre leachate retention pond located south of Old St. Charles Rock Road, which has been fitted with the four aerators originally installed in the biological treatment lagoon. Leachate is subsequently discharged to the MSD system. The original leachate treatment system is currently inactive (Midwest Environmental, 1994).

Table 2-4 summarizes leachate collection system well designations, usage, and locations.

2.5.3 Landfill Gas Collection System

A well, collection, blower, and flare system controls gases generated by decomposition of landfilled materials (Figure 2-21). The system was initially designed in 1981 in order to alleviate landfill odors determined to originate from the open landfill, a 24-inch drainpipe (probably collection well A in the north quarry pit), and the quarry pond (Black Diamond Lake) (Reitz & Jens, Mar. 2, 1981). Odors emanating from the landfill and pond were addressed by earth and chemical covers, respectively; the odors from the drainpipe were addressed by a gas collection system. A combustion unit was installed in the summer of 1981 to oxidize vapors from the pipe (Reitz & Jens, Nov. 18, 1981). A new leachate collection well installed in August 1981 also presented an odor problem, and was similarly connected to the burner (Reitz & Jens. Nov. 18, 1981).

In 1982, settling of cover materials along Taussig Road (immediately east of the north quarry pit) allowed landfill gases to escape, necessitating expansion of the gas collection system (Reitz & Jens, Mar. 8, 1982). Four gas collection wells were drilled into the rock windrow adjacent to the pit wall, connected to a header system and the gas burner.

The gas collection system was expanded to include six additional collection wells located southwest of the blower location. A trench rock well system was installed to collect landfill gas in the former Black Diamond Lake pit area. Expansion of the landfill into the south pit necessitated further modification of the gas collection system to include additional gas collection wells and an enclosed flare with increased capacity. The active landfill system collects gas from the four leachate collection sumps and four additional gas collection wells. These eight collection points are connected to a dual above-grade header system which leads to the gas flare.

2.5.4 Landfill Fire

In 1993 an underground fire of unknown origin was detected along the northern quarry wall of the area originally permitted under Permit No. 118909, immediately east of the flare station (Figure 2-21). To determine the extent of the fire, SCS Engineers of Cincinnati, Ohio conducted an infrared thermograph study. The results of the study in conjunction with temperature probe information showed that the fire was concentrated immediately surrounding the quarry wall, east of the flare station (SCS, May 17, 1994). No underground lateral migration was detected. The area which separated from the quarry wall has been sealed with cement slurry. Temperature probes continue to be monitored.

2.5.5 Groundwater Monitoring System

Groundwater monitoring well installations generally followed site landfilling development. Various alluvial groundwater monitoring investigations have been conducted at the site, beginning as early as 1973. Initial wells were installed around the 118903 permit area (inactive landfill), and were followed by additional wells around both areas of OU-1 and the 218903 permit area (demolition landfill). The initiation of landfilling in the former quarry pit areas led to installation of groundwater monitoring wells in this area of the site. During the 1986 Burns & McDonnell hydrogeologic investigation, existing and new monitoring wells were designated with alphabetic codes according to completion depth (S = shallow, I = intermediate, and D = deep).

Wells completed within bedrock materials (near the south quarry pit) and installed subsequent to the Burns & McDonnell investigation did not follow the same well identification pattern. Three wells, currently designated 1201, 1202, and 1203, were installed in 1985 to monitor the effectiveness of a grout curtain installed to control seepage in the south pit area. Four wells installed in 1990 were given "MW" prefixes. Wells MW-F1S and MW-F1D are located near the center of the site. Wells MW-F2 and MW-F3 are located near Old St. Charles Rock Road and northeast of the demolition landfill area, respectively. In 1991, three additional wells, designated 1204, 1205, and 1206, were installed south and west of the south quarry pit, and wells 1202 and 1203 were concurrently abandoned. The current groundwater monitoring system consists of wells 1201, 1204, 1205, and 1206 (Figure 2-22). All other wells are inactive, abandoned, or missing.

A summary of monitoring wells at the site is provided in Table 2-5; all site groundwater monitoring wells are depicted in Figure 2-6.

TABLE 2-1

GENERALIZED STRATIGRAPHIC COLUMN FOR ST. LOUIS, ST. CHARLES, AND JEFFERSON COUNTIES, MISSOURI

System	Series	Group	Formation	Thickness (feet)	Dominant Lithology	Water-Bearing Character
Quaternary	Holocene		Alluvium	0-150	Sand, gravel, silt, and clay.	Some wells yield more than 2,000 gpm.
	Pleistocene		Loess Glacial Till	1-110 0-55	Silt Pebbly clay and silt.	Essentially not water yielding.
Pennsylvanian	Missourian	Pleasanton	Undifferentiated	0-75	Shales, siltstones, "dirty" sandstones, coal beds and thin limestone beds.	Generally yields very small quantities of water to wells. Yields range from 0-10 gpm.
	Desmoinesian	Marmaton	Undifferentiated	0-90		
		Cherokee	Undifferentiated	0-200		
	Atokan		Undifferentiated			
Mississippian	Meramecian		Ste. Genevieve Formation	0-160	Argillaceous to arenaceous limestone.	Yields small to moderate quantities of water to wells. Yields range from 5 to 50 gpm. Higher yields are reported for this interval locally.
			St. Louis Limestone	0-180		
			Salem Formation	0-180		
			Warsaw Formation	0-110	Shales in upper portion, limestone in lower portions.	
	Osagean		Burlington-Keokuk Limestone	0-240	Cherty limestone	
			Fern Glen Formation	0-105	Red limestone and shale.	
	Kinderhookian	Chouteau	Undifferentiated	0-122	Limestone, dolomitic limestone, shale and siltstone.	
Devonian	Upper	Sulphur Springs	Bushberg Sandstone	0-60	Limestone and sandstone	
			Glen Park Limestone			
			Grassy Creek Shale	0-50	Fissile, carbonaceous shale	
Silurian			Undifferentiated	0-200	Cherty Limestone	

NOTES: Basal part of alluvium may be of Pleistocene age.
Stratigraphic nomenclature may not necessarily be that of the U.S. Geological Survey.
Aquifers most favorable as water sources are shaded.
Double-line indicates unconformity.

SOURCE: *Water Resources of the St. Louis Area, Missouri.* (Miller, et. al., 1974).

TABLE 2-1

GENERALIZED STRATIGRAPHIC COLUMN FOR ST. LOUIS, ST. CHARLES, AND JEFFERSON COUNTIES, MISSOURI

System	Series	Group	Formation	Thickness (feet)	Dominant Lithology	Water-Bearing Character
Ordovician	Cincinnation		Maquoketa Shale	0-163	Silty, calcareous or dolomitic shale.	Probably constitutes a confining influence on water movement.
			Cape Limestone	0-5	Argillaceous limestone.	Yields small to moderate quantities of water to wells. Yields range from 3 to 50 gpm. Decorah Formation probably acts as a confining bed locally.
	Champlainian		Kimmswick Formation	0-145	Massive limestone	
			Decorah Formation	0-50	Shale with interbedded limestone	
			Plattin Formation	0-240	Finely crystalline limestone	
			Rock Levee Formation	0-93	Dolomite and limestone, some shale.	
			Joachim Dolomite	0-135	Primarily argillaceous dolomite.	
			St. Peter Sandstone	0-160	Silty sandstone, cherty limestone grading upward into quartzose sandstone	Yields moderate quantities of water to wells. Yields range from 10-140 gpm.
			Everton Formation	0-130		
	Canadian		Powell Dolomite	0-150	Sandy and cherty dolomites and sandstone	Yields small to large quantities of water to wells. Yields range from 10 to 300 gpm. Upper part of aquifer group yields only small amounts of water to wells.
			Cotter Dolomite	0-320		
			Jefferson City Dolomite	0-225		
			Roubidoux Formation	0-177		
			Gasconade Dolomite Gunter Sandstone Member	0-280		
Cambrian	Upper		Eminence Dolomite	0-172	Cherty dolomites, siltstones, sandstone, and shale.	Yields moderate to large quantities of water to wells. Yields range from 10 to 400 gpm.
			Potosi Dolomite	0-325		
		Elvins	Derby-Doerun Dolomite	0-165		
			Davis Formation	0-150		
			Bonneterre Formation	245-385		
			Lamotte Sandstone	235+		
Precambrian					Igneous and metamorphic rocks.	Does not yield water to wells in this area.

NOTES: Basal part of alluvium may be of Pleistocene age.
Stratigraphic nomenclature may not necessarily be that of the U.S. Geological Survey.
Aquifers most favorable as water sources are shaded.
Double-line indicates unconformity.

SOURCE: *Water Resources of the St. Louis Area, Missouri.* (Miller, et. al., 1974).

TABLE 2-2

PREVIOUS INVESTIGATION SUMMARY

Year(s)	Investigation Conducted for:	Description
1973	West Lake Landfill	Four wells at unknown locations were sampled for five sampling rounds; samples were analyzed for general inorganic parameters, metals, and phenol.
1976	West Lake Quarry	Three wells along the western property boundary were sampled in one sampling round; samples were analyzed for general inorganic parameters, metals, and phenol.
1976-1984	West Lake Quarry	Wells around the perimeter of the inactive landfill on the western portion of the site, and after 1981 near the leachate retention pond, were sampled intermittently. Samples were analyzed for a varying list of parameters which included general inorganic parameters, ions, metals, and radionuclides.
1979-1982	Missouri Department of Natural Resources	Wells around the perimeter of the inactive landfill and the perimeter of the site, as well as site surface water bodies and off-site private wells, were sample intermittently. The samples were analyzed for a varying list of general inorganic parameters, ions, metals, and radionuclides.
1982	Nuclear Regulatory Commission	The *Radiological Survey of the West Lake Landfill, St. Louis County, Missouri* identified two areas of radiological contamination on-site, and concluded that there is no indication of off-site migration of the contaminants.
1983	College of Engineering, University of Missouri-Columbia	The *Engineering Evaluation of Options for Disposition of Radioactively Contaminated Residues Presently in the West Lake Landfill, St. Louis County, Missouri, Draft* identified radiological contamination and concluded that radon gas release from the site would increase.
1984	Nuclear Regulatory Commission	The perimeter berm around the northern extent of the site was surveyed for radiological contamination and inspected for erosion. Migration of contamination and slope failure were observed on selected portions of the berm west of OU-2 Area 2.

TABLE 2-2

PREVIOUS INVESTIGATION SUMMARY

Year(s)	Investigation Conducted for:	Description
1986	West Lake Landfill	Existing and new wells around the inactive landfill on the western portion of the site, and the leachate retention pond, were included in a thorough hydrogeologic investigation. The hydrogeologic characterization concluded that three levels of the alluvial aquifer (shallow, intermediate, and deep) were in complete communication, and that groundwater flow was generally towards the northwest. Groundwater samples were collected and analyzed for volatile organic compounds, acid-base neutral extractables, pesticides and polychlorinated biphenyls, phenol, cyanide, and metals. Concentrations of certain parameters exceeded applicable standards, but the distribution was erratic and generally could not be attributed specifically to site activities. Concentrations of parameters which exceeded standards were likely to be diluted below standards prior to exposure to any downgradient uses.
1986	Nuclear Regulatory Commission	Eighteen groundwater monitoring wells were sampled and analyzed for radionuclides.
1989 and 1991	Environmental Protection Agency	A review of historical aerial photographs, from 1941 through 1991, was conducted to identify areas of potential environmental concern. Solid waste and mine spoils areas were identified.
1989 to Present	Laidlaw Waste Systems	Groundwater samples were collected from wells throughout the site on an intermittent basis, focussing specifically on wells around the active landfill area in recent years. Samples were analyzed for a variable list of parameters, including general inorganics, metals, radionuclides, volatile organic compounds, pesticides, herbicides, polychlorinated biphenyls, cyanide, and phenol.
1990-1991	Earth City Industrial Park	An investigation of potential radiological impacts to neighboring properties was conducted in three phases. Radiological contamination reportedly originating from OU-1 Area 2 was identified in soils at two hot spots near the property boundary.
1991	Agency for Toxic Substances and Disease Registry	A review of available information concluded that the site presented no apparent health hazard, although exposure could occur if groundwater contamination increased and migrated off-site.
1991	Laidlaw Waste Systems	A subsurface soil gas survey conducted in the vicinity of MW-F2 identified BTEX and TPH impacts to subsurface soils in an area extending 150 feet north and 300 feet south of MW-F2.

TABLE 2-2

PREVIOUS INVESTIGATION SUMMARY

Year(s)	Investigation Conducted for:	Description
1992	Laidlaw Waste Systems	An environmental investigation for the development of a site Health and Safety Plan identified radon in the landfill gas collection system.
1992	Laidlaw Waste Systems	The slope of the berm along the western portion of the inactive landfill was reworked to 3H:1V, recovered, and revegetated.
1993	Laidlaw Waste Systems	A health impact assessment concluded that radiological contaminants from site sources were not a threat to site workers, the general public, or the environment.
1994	Laidlaw Waste Systems	A health assessment analyzed chemical constituents of the landfill gas collection system and concluded that landfill gas composition was similar to EPA-reported averages, and that exposures to site workers were below analytical detection limits.
1994	OU-1 Respondent Group	An overland gamma survey conducted in and in the immediate vicinity of OU-1 identified radiologically-contaminated hot spots both inside and outside of OU-1 boundaries, and recommended alteration of those boundaries.

TABLE 2-3

LANDFILL PERMITS

Number	Type	Acreage	Issue Date	Consultant	Comments
118903	Sanitary	25	1/27/76	Rogers and Associates	Actual authorization granted on 8/27/94
Addendum	Expansion	3.5	5/23/78	Paul H. Himebaugh	
218903	Demolition	27	1/27/76	Rogers and Associates	Includes areas 1,3,5, and 6
118906	Sanitary	13	1/22/79	Paul H. Himebaugh	
118908	Sanitary	6	8/27/80	Reitz and Jens, Inc.	
118909	Sanitary	9	8/20/81	Reitz and Jens, Inc.	
218912	Demolition	22	9/19/84	Burns and Mc Donnell	
118912	Sanitary	52	11/18/85	Burns and Mc Donnell	Supersedes Permit Nos. 118909 and 118906. Represents a 33 acre expansion from area under those permits.

TABLE 2-4

LEACHATE COLLECTION SYSTEM WELLS

Well Original Designation	Well New Designation(s)	Status	Location
A	69Q	Inactive	Northeast corner of 118906 permit area
B	74, K128	Active	Eastern Border of 118903 permit area
C	57	Inactive	Western border of 118903 permit area
D	71Q, LCW-D	Inactive	Black Diamond Lake pit
E	70Q, LCW-E	Inactive	Black Diamond Lake pit
K100	LCS-2	Active	South corner of 118912 permit area
K123	LCS-1	Active	North corner of 118912 permit area
K124	LCS-3	Active	East corner of 118912 permit area
K125	LCS-4	Active	West corner of 118912 permit area

TABLE 2-5
GROUNDWATER MONITORING WELL SUMMARY

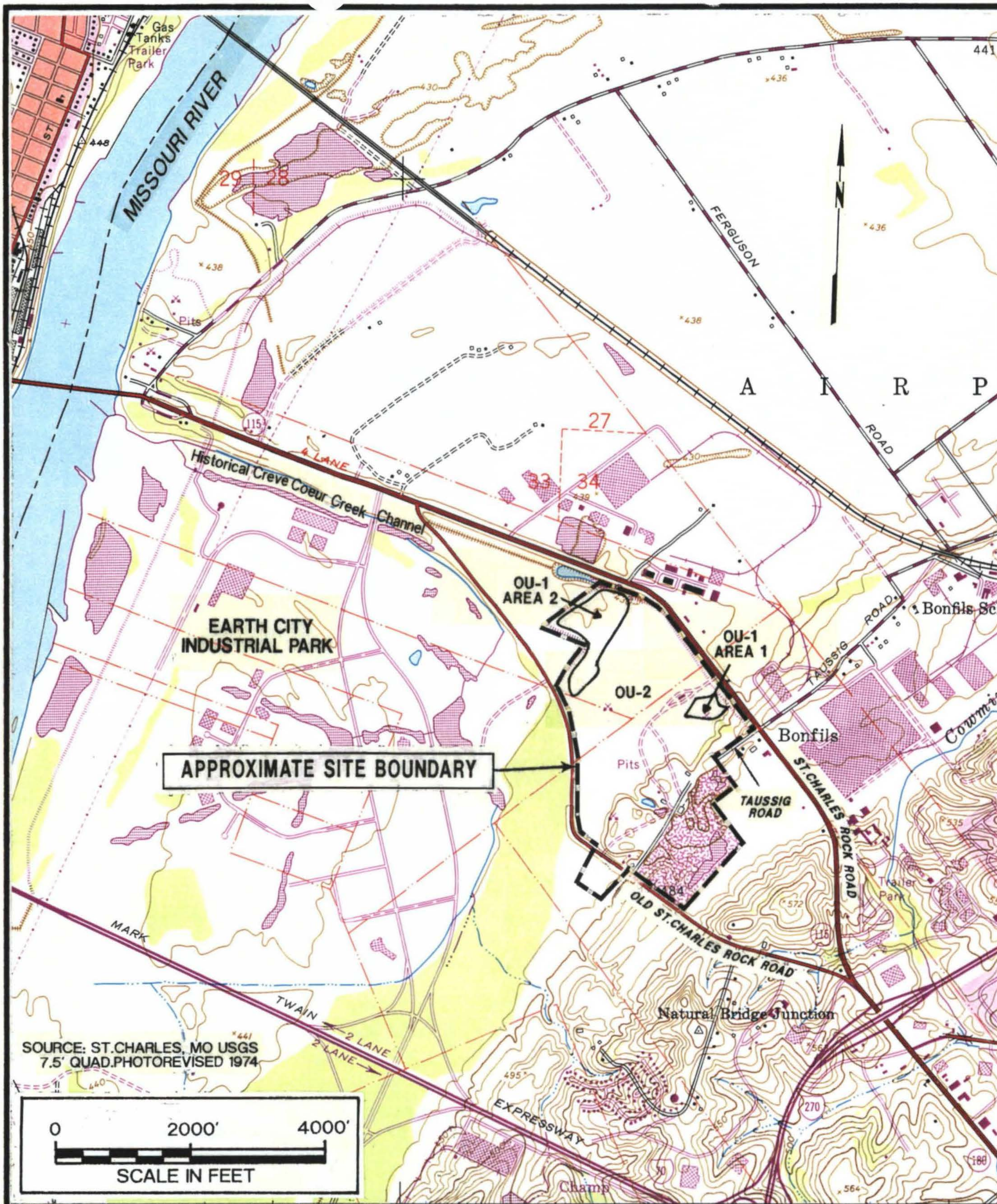
Installation Date	Original Designation	Current Designation	Current Status	Coordinates North	Coordinates East	Elevation (ft msl) Ground Surface	Elevation (ft msl) Top Of Casing	Elevation (ft msl) Screen Interval	Depth	Boring Log	Well Construction Information	Drilling Company	Consultant
10/83	N-1	I-50	Inactive	5,200	3,840	449.0	453.48	418.4-408.4	40.6	No	No	Unknown	Reitz & Jens
81	HL-3	S-51	Missing	6,140	4,200	446.3	447.72	423.5-420.5	25.8	No	No	Unknown	Reitz & Jens
81	HL-2	S-52	Inactive	6,470	4,200	444.7	447.08	422.5-419.5	25.2	No	No	Unknown	Reitz & Jens
81	HL-1	S-53	Inactive	6,880	4,500	444.8	449.00	424.1-421.1	23.7	No	No	Unknown	Reitz & Jens
Unknown	36	S-54	Abandoned 10/92	1,067,606	514,468	470.0	N/A	N/A	40.4	No	No	Unknown	Unknown
6/78	35	I-55	Abandoned 10/92	1,067,787	514,475	471.9	N/A	N/A	60.0	Yes	Yes	Wabash Drilling	None
6/78	34	I-56	Abandoned 10/92	1,068,057	514,487	475.1	N/A	N/A	61.1	Yes	Yes	Wabash Drilling	None
6/78	40	I-58	Abandoned 10/92	1,068,874	514,458	477.5	N/A	N/A	60.0	Yes	Yes	Wabash Drilling	None
10/83	N-2	I-59	Abandoned 10/92	1,069,332	514,289	444.9	N/A	N/A	43.5	No	No	Unknown	Reitz & Jens
7/81	S-2	S-60	Inactive	9,750	4,310	443.1	446.93	?-422.1	21.0	No	No	Unknown	Unknown
7/81	S-1	S-61	Inactive	70,160	4,580	445.6	450.17	?-424.1	21.5	No	No	Unknown	Unknown
10/83	N-3	I-62	Inactive	70,960	4,675	444.1	446.08	410.1-400.1	44.0	No	No	Unknown	Reitz & Jens
10/83	N-4	I-65	Inactive	70,940	5,435	438.5	441.80	412.5-402.5	36.0	No	No	Unknown	Reitz & Jens
10/83	N-5	I-66	Inactive	70,520	5,935	437.7	441.80	410.8-400.8	36.9	No	No	Unknown	Reitz & Jens
10/83	N-6	I-67	Inactive	70,090	6,260	436.5	439.08	411.1-401.1	35.4	No	No	Unknown	Reitz & Jens
10/83	N-7	I-68	Inactive	9,570	6,690	440.9	448.32	419.7-409.7	31.2	No	No	Unknown	Reitz & Jens
6/78	39	I-72	Inactive	7,890	5,345	462.7	465.40	415.7-412.7	50.0	Yes	Yes	Wabash Drilling	None
6/78	38	I-73	Inactive	7,680	5,575	458.9	462.60	415.7-412.7	50.0	Yes	Yes	Wabash Drilling	None
Unknown	37	S-75	Inactive	7,270	4,730	458.8	459.90	435.8-432.8	26.0	No	No	Wabash Drilling	Unknown
6/78	37A	S 76	Abandonded 10/92	1,067,406	514,569	474.4	N/A	N/A	50.0	Yes	Yes	Wabash Drilling	None
6/78	41	41	Abandonded 10/92	1,069,287	514,377	N/A	N/A	N/A	N/A	Yes	Yes	Wabash Drilling	None
8/84	S-80	S-80	Inactive	5,190	3,870	448.4	453.38	438.4-428.4	20.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	D-81	D-81	Inactive	1,067,338	514,464	447.8	450.91	402.8-387.8	60.0	Yes	Yes	Wabash Drilling	Burns & McDonnell

N/A = Not Applicable
Elevations provided in feet above mean sea level (msl).

TABLE 2-5
GROUNDWATER MONITORING WELL SUMMARY

Installation Date	Original Designation	Current Designation	Current Status	Coordinates North	Coordinates East	Elevation (ft msl) Ground Surface	Elevation (ft msl) Top Of Casing	Elevation (ft msl) Screen Interval	Depth	Boring Log	Well Construction Information	Drilling Company	Consultant
8/84	S-82	S-82	Inactive	1,069,312	514,273	447.7	450.66	432.2-422.2	25.5	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	D-83	D-83	Inactive	70,940	4,660	444.4	447.62	367.4-347.4	97.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	S-84	S-84	Inactive	9,685	6,455	452.9	456.92	432.0-422.0	30.9	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	D-85	D-85	Inactive	9,680	6,445	453.1	457.15	391.1-371.1	8.2	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	D-87	D-87	Inactive	9,210	5,400	460.0	463.04	369.0-349.0	111.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	S-88	S-88	Inactive	8,390	5,270	460.0	462.73	430.0-420.0	40.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/84	D-89	D-89	Inactive	6,970	5,100	454.1	457.10	420.1-405.1	49.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/85	D-90	D-90	Inactive	6,160	4,300	446.0	450.60	409-399	47.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
8/85	D-91	D-91	Missing	5,220	3,770	448.0	453.37	413-403	45.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
4/85	D-92	D-92	Missing	9,760	5,090	475.5	475.37	352.5-332.5	143.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
4/85	D-93	D-93	Inactive	1,069,318	514,270	448.0	449.95	356-336	112.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
4/85	D-94	D-94	Inactive	70,645	5,820	438.5	442.68	352.5-332.5	106.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
4/85	D-95	D-95	Missing	N/A	N/A	450.0	453.09	369-349	101.0	Yes	Yes	Wabash Drilling	Burns & McDonnell
3/85	4/3	1201	Active	1,067,303	516,903	480.6	482.84	427.6-230.6	250.0	Yes	Yes	Drilling Service Co.	Burns & McDonnell
3/85	14/3	1202	Abandonded 3/91	1,067,343	516,875	480.5	N/A	N/A	250.0	Yes	Yes	Drilling Service Co.	Burns & McDonnell
7/85	17/4	1203	Abandonded 3/91	1,067,189	516,955	481.1	N/A	N/A	250.0	Yes	Yes	Drilling Service Co.	Burns & McDonnell
4/91	1204	1204	Active	1,066,421	515,823	483.3	485.63	269.8-259.8	223.5	Yes	Yes	Mathes & Associates	Foth & Van Dyke
4/91	1205	1205	Active	1,067,387	515,621	384.5	386.77	271.5-261.5	123.0	Yes	Yes	Mathes & Associates	Foth & Van Dyke
3/91	1206	1206	Active	1,067,396	515,624	386.2	388.48	323.2-313.2	73.0	Yes	Yes	Mathes & Associates	Foth & Van Dyke
8/90	MW-F1S	MW-F1S	Inactive	8,595	5,890	N/A	N/A	10	32.5	Yes	Yes	Brotcke Engineering	Foth & Van Dyke
8/90	MW-F1D	MW-F1D	Inactive	8,600	5,805	N/A	N/A	5	79.1	Yes	Yes	Brotcke Engineering	Foth & Van Dyke
8/90	MW-F2	MW-F2	Inactive	1,067,685	514,417	447.9	450.1	437.6-422.6	25.3	Yes	Yes	Brotcke Engineering	Foth & Van Dyke
8/90	MW-F3	MW-F3	Inactive	70,380	5,880	N/A	N/A	10	42.8	Yes	Yes	Brotcke Engineering	Foth & Van Dyke

N/A = Not Applicable
Elevations provided in feet above mean sea level (msl).



Golder Associates

Denver, Colorado

TITLE

SITE LOCATION MAP

CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN BDL	DATE APRIL 1995	JOB NO. 943-2848.101
	CHECKED CER	SCALE 1:24,000	DWG NO./REV. NO.
	REVIEWED WEH	FILE NO.	FIGURE NO. 2-1

Golder Associates Denver, Colorado

TITLE

SITE VICINITY MAP

CLIENT/PROJECT		DRAWN BDL	DATE APRIL 1995	JOB NO. 943-2848.101
LAIDLAW	WEST LAKE LANDFILL OPERABLE UNIT 2	CHECKED CER	SCALE 1:50,000	DWG NO./REV. NO.
LAIDLAW WASTE SYSTEMS INC.		REVIEWED WEH	FILE NO.	FIGURE NO. 2-2

LEGEND

———	ST.LOUIS COUNTY/CITY OF BRIDGETON BOUNDARY
- - - - -	ZONING BOUNDARY
▨	PERMITTED SANITARY LANDFILL AREA

SOURCE: *THE ZONING MAP OF THE CITY OF BRIDGETON, 1982 AS AMENDED. INTERVIEW WITH COUNTY OF ST. LOUIS ZONING BOARD, 1995*

ZONING CODES

CITY OF BRIDGETON	R-1	ONE-FAMILY DWELLING DISTRICT
	R-3	ONE-FAMILY DWELLING DISTRICT
	B-3	TRAVEL/ENTERTAINMENT SERVICES DISTRICT
	B-4	GENERAL COMMERCIAL DISTRICT
	$B-5_f$	PLANNED COMMERCIAL DISTRICT: WEST LAKE QUARRY TRACT
	$B-5_e$	PLANNED COMMERCIAL/PROFESSIONAL DISTRICT
	M-1	MANUFACTURING DISTRICT, LIMITED
	M-2	MANUFACTURING DISTRICT
	$M-3_g$	PLANNED MANUFACTURING DISTRICT: NORTHWEST INDUSTRIAL PARK
	$M-3_n$	PLANNED MANUFACTURING DISTRICT: WEST LAKE QUARRY TRACT
ST. LOUIS COUNTY	C-8	PLANNED COMMERCIAL DISTRICT
	M-3	PLANNED INDUSTRIAL DISTRICT
	NU	FLOOD PLAIN

NORTH

SCALE IN FEET
0 150 300 600

NOTES:
1. INDUSTRIAL USES AT THE SITE ARE NON-CONFORMING USES WITH CURRENT ZONING.
2. RESIDENTIAL ZONING NEAR THE SITE HAS BEEN DEEMED UNCONSTITUTIONAL. SEE TEXT FOR DISCUSSION.

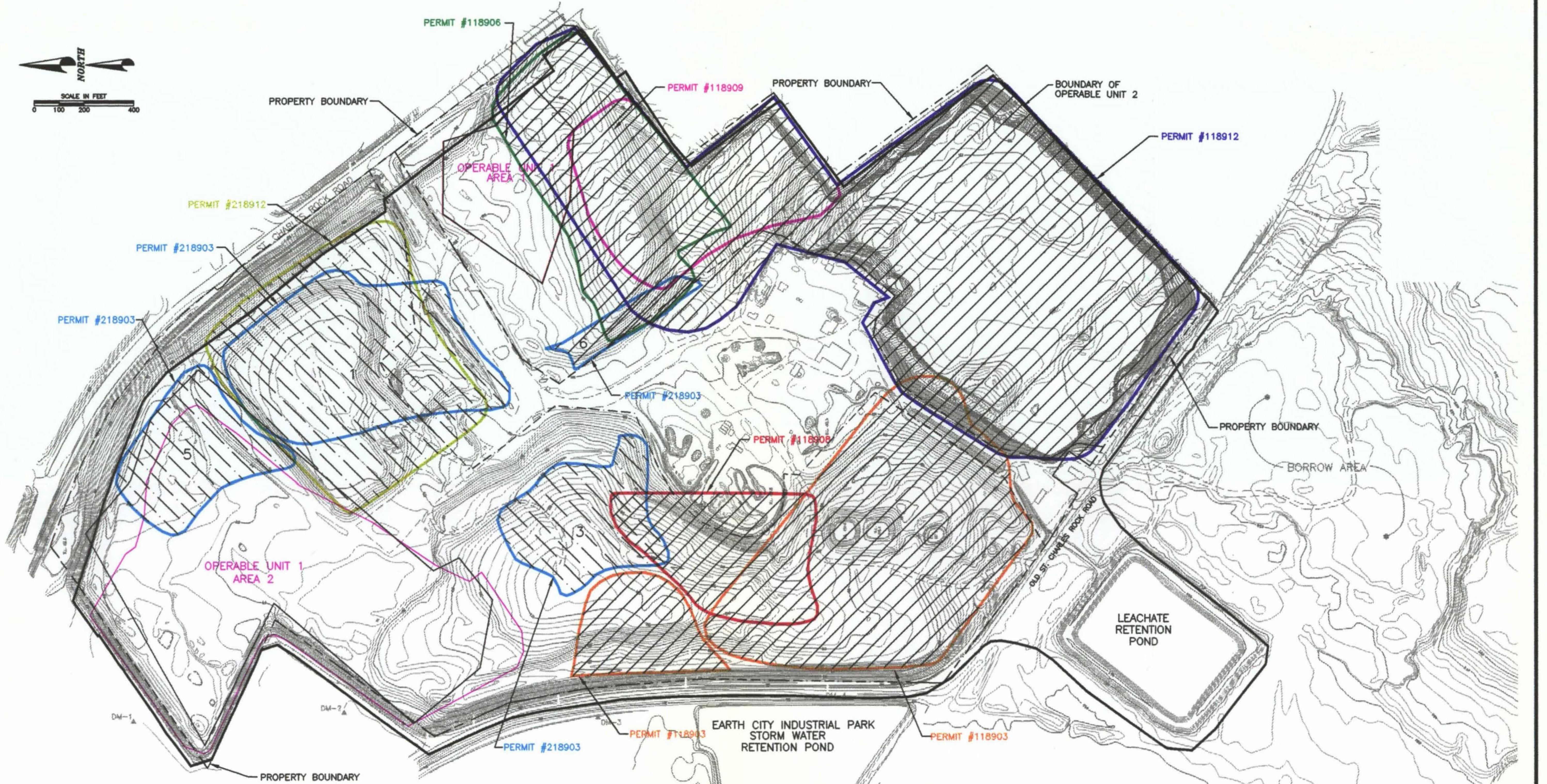
REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT: LAIDLAW — LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2

TITLE: ZONING AND LAND USE MAP

Golder Associates — Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D008
FILE NO.	2848D008	FIGURE	2-3



LEGEND	
	SOLID WASTE PERMIT
	DEMOLITION PERMIT

PERMIT HISTORY

NO.	TYPE	ACREAGE	ISSUE DATE	COMMENTS
118903	SANITARY	25	1/27/76	ACTUAL AUTHORIZATION GRANTED ON 8/27/74
218903	DEMOLITION	27	1/27/76	USED FOR SANITARY WASTE DISPOSAL PRIOR TO ISSUANCE OF DEMOLITION FILL PERMIT
118903	SANITARY	3.5	5/23/78	EXPANSION OF ORIGINAL 25-ACRE TRACT
118906	SANITARY	13	1/22/79	
118908	SANITARY	6	8/27/80	
118909	SANITARY	9	8/20/81	
218912	DEMOLITION	22	9/19/84	
118912	SANITARY	52	11/18/85	SUPERSEDES PERMIT 118909 AND 118906, PLUS 33 ACRES, PER EXPANSION

NOTE: AREAS 1 THROUGH 6 WERE IDENTIFIED AS WASTE DISPOSAL AREAS BY THE MDNR IN 1974. AREAS 1, 3, 5, AND 6 WERE PERMITTED BY THE MDNR UNDER 218903. AREAS 2 AND 4 WERE NOT PERMITTED, AND WERE CLOSED BY MDNR IN 1974.

SOURCE: *PERMIT CONSOLIDATION ENGINEERING REPORT, DRAFT:* MIDWEST ENVIRONMENTAL CONSULTANTS, P.C. OCTOBER 1994

Golder Associates — Denver, Colorado

CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2

TITLE: **MDNR - PERMITTED LANDFILL AREAS**

DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B009
REVIEWED	WEH	FILE NO.	2848B009	FIGURE NO.	2-4

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT: LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE: SITE FEATURES MAP

Golder Associates
Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D030
FILE NO.	2848D030	FIGURE	2-5

CLIENT/PROJECT	
LAIDLAW LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2

TITLE

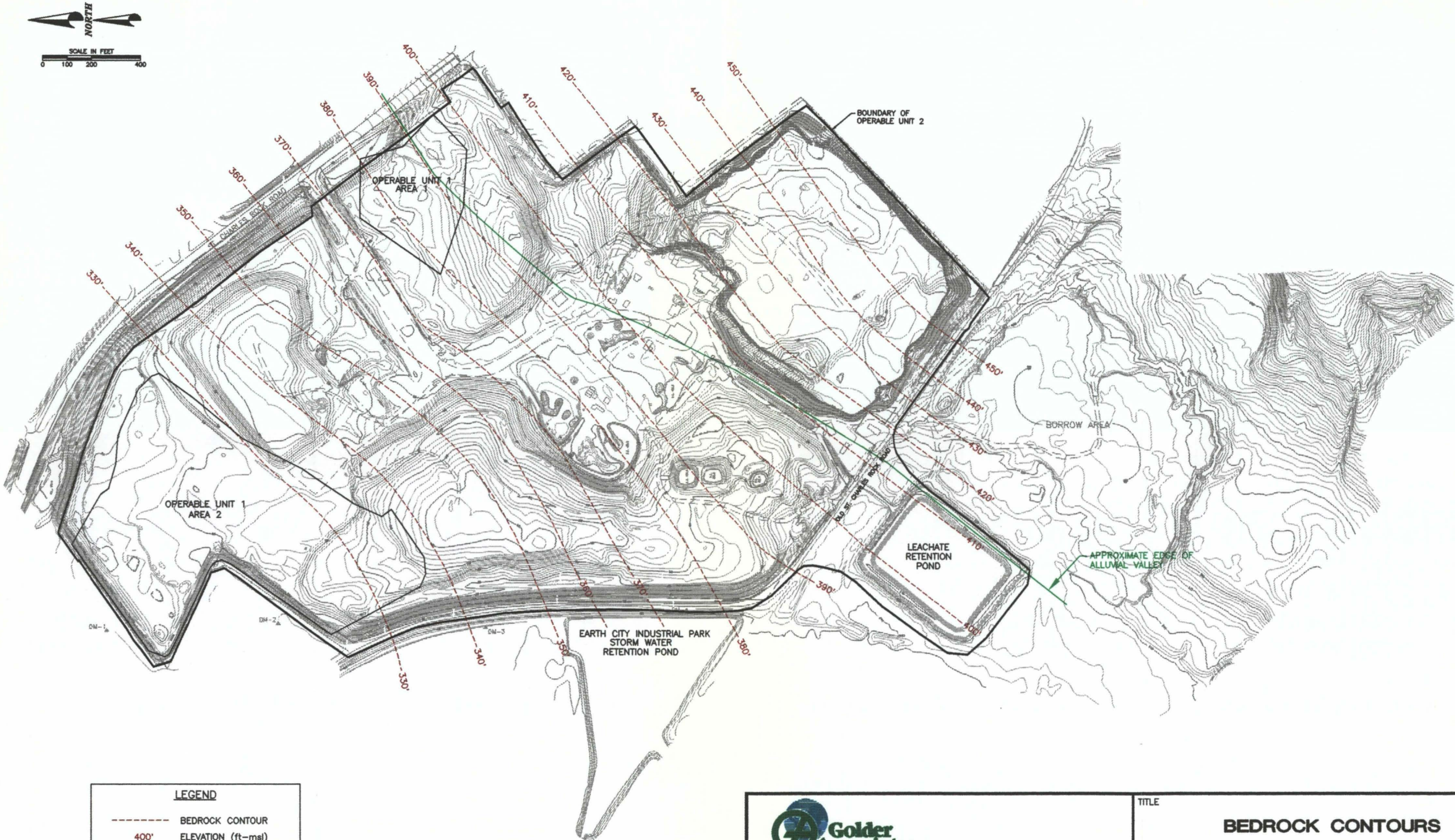
SITE GROUNDWATER MONITORING WELLS

Golder Associates

Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	weh	JOB NO.	943-2848
APPROVED		DWG. NO.	D044
FILE NO.	2848D044	FIGURE	2-6

REV.	DATE	DESCRIPTION	DR. BY	APP. BY



LEGEND

- - - - - - - -	BEDROCK CONTOUR
400'	ELEVATION (ft-msl)

SOURCE: McLAREN/HART 1994

NOTE: PRE-QUARRY BEDROCK CONTOURS IN THE ACTIVE LANDFILL HAVE BEEN INFERRED BY McLAREN/HART AND HAVE BEEN MODIFIED BY MINING ACTIVITIES.

Golder Associates, Denver, Colorado	TITLE: **BEDROCK CONTOURS**		
CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN: TMC	DATE: APRIL 1995	JOB NO. 943-2848
	CHECKED: CER	SCALE: AS SHOWN	DWG. NO./REV. NO. B043
	REVIEWED: WEH	FILE NO. 2848B043	FIGURE NO. **2-7**

LEGEND

—	1941
—	1953
—	1958
—	1965
—	1968
—	1971
—	1974
—	1977
—	1979
—	1982
—	1985
—	1989
—	ALL YEARS

SOURCE: EPA, 1989

NOTES:
1. POTENTIAL LIQUID WASTE DISPOSAL AREAS WERE INFERRED BY THE EPA. BASED ON REVIEW OF HISTORIC AERIAL PHOTOGRAPHS.
2. POTENTIAL LIQUID WASTE DISPOSAL AREAS SHOWN ON THIS FIGURE EXCLUDE STANDING LIQUIDS RELATED TO STORMWATER ACCUMLATION OR QUARRY DEWATERING.

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT: LAIDLAW — LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE: POTENTIAL LIQUID WASTE DISPOSAL AREAS INFERRED BY THE EPA

Golder Associates — Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D022
FILE NO.	2848D022	FIGURE	2-8

LEGEND

1977
1979
1982
1985

NOTES:

1. POTENTIAL SLUDGE DISPOSAL AREAS HAVE BEEN INFERRED BY THE EPA, BASED ON REVIEW OF THE HISTORIC AERIAL PHOTOGRAPHS.
2. POTENTIAL SLUDGE DISPOSAL AREAS SHOWN ON THE FIGURE. EXCLUDE CONCRETE SLUDGE DISPOSAL AREAS.

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

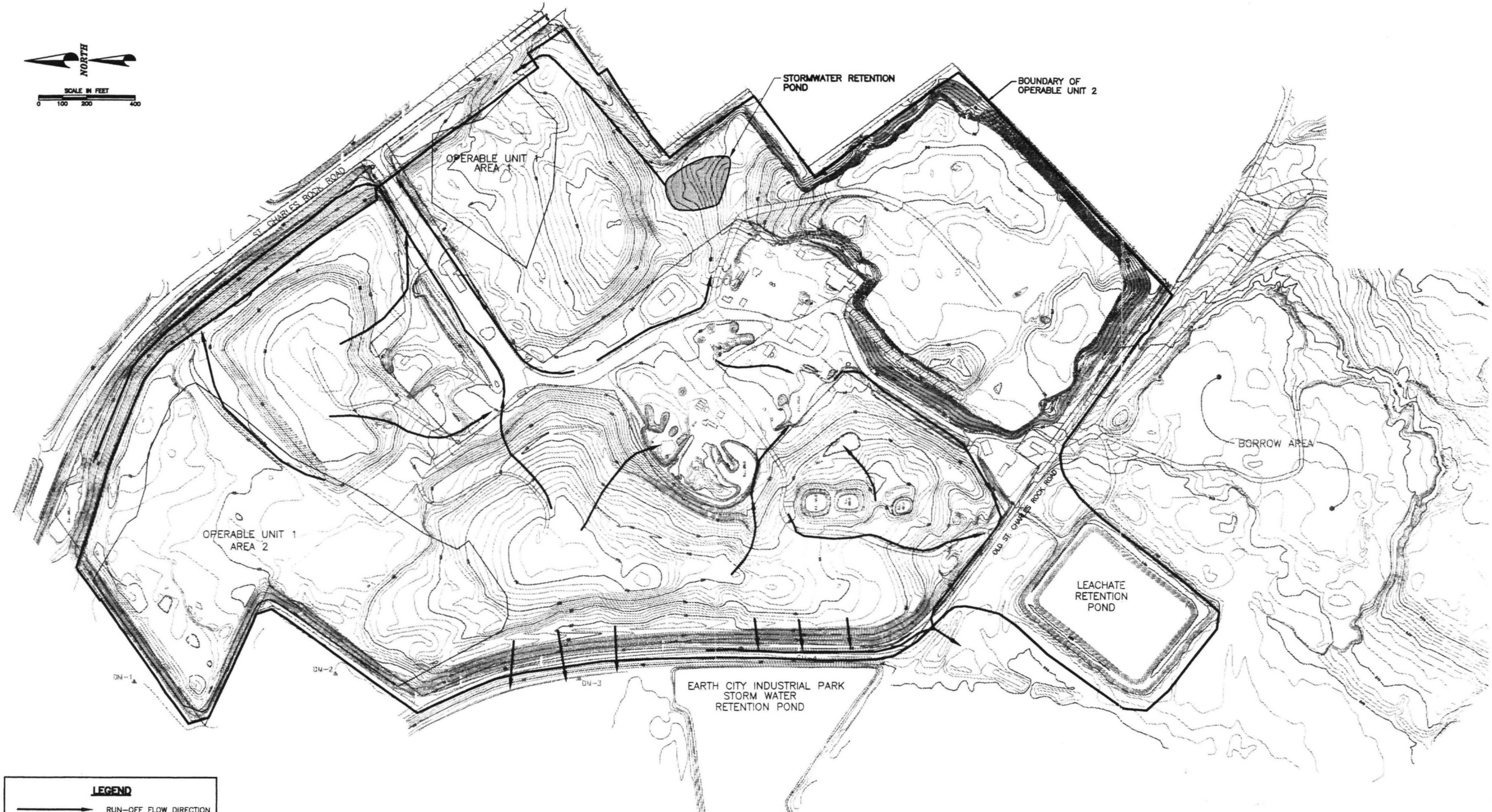
CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE
POTENTIAL SLUDGE DISPOSAL
AREAS INFERRED BY THE EPA

Golder Associates
Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D023
FILE NO.	2848D023	FIGURE	2-9



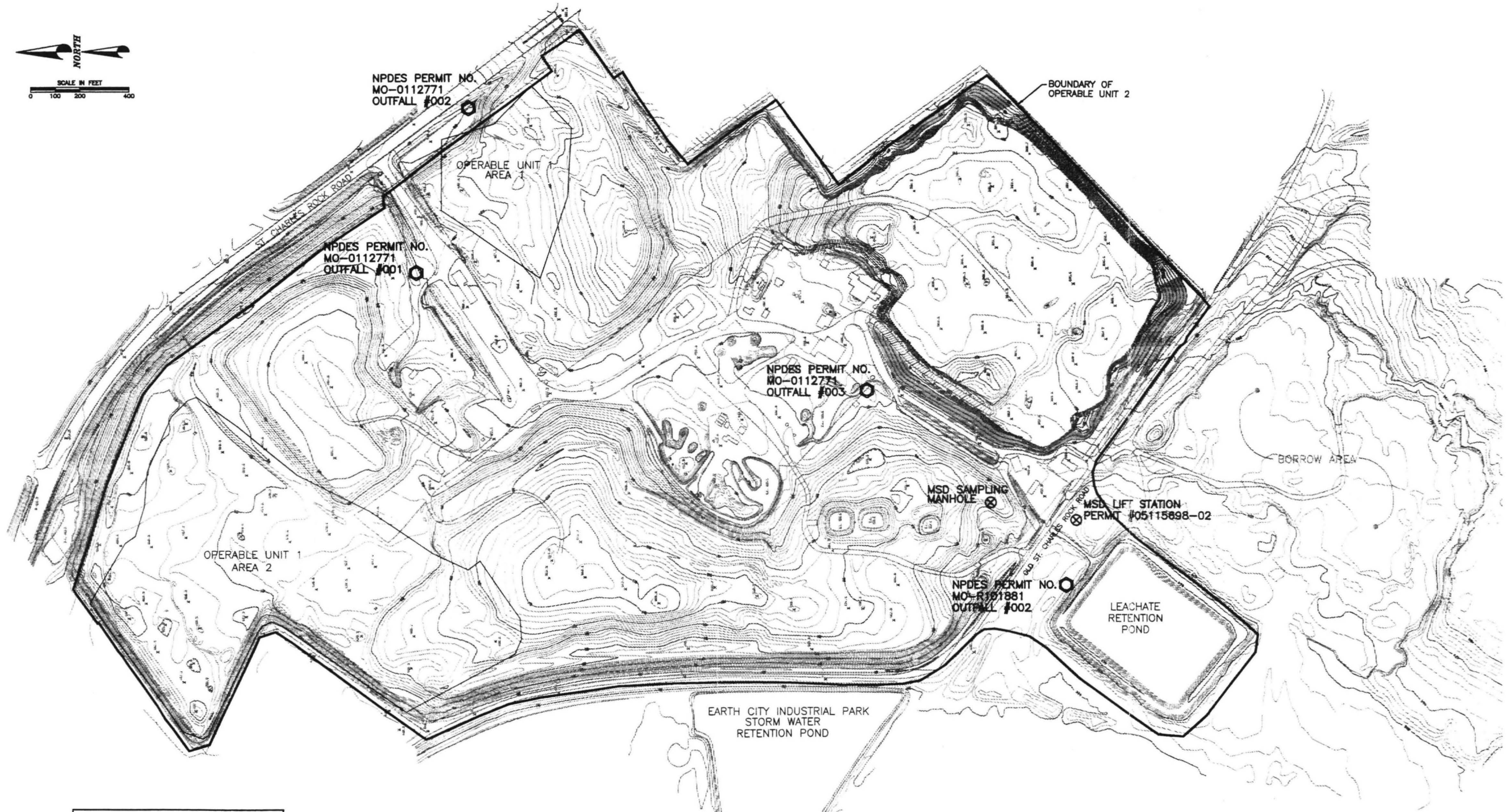
LEGEND

RUN-OFF FLOW DIRECTION

TOPOGRAPHY NORTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1994

TOPOGRAPHY SOUTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1992

Golder Associates, Denver, Colorado	TITLE: SURFACE WATER DRAINAGE			
CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995	JOB NO. 943-2848
	CHECKED CER	SCALE AS SHOWN	DWG. NO./REV. NO. B002
	REVIEWED WEH	FILE NO. 2848B002	FIGURE NO. 2-10



LEGEND

- NPDES OUTFALL
- LEACHATE MONITORING MANHOLE (MSD MH)

Golder Associates — Denver, Colorado

CLIENT/PROJECT: LAIDLAW — LAIDLAW WASTE SYSTEMS INC.

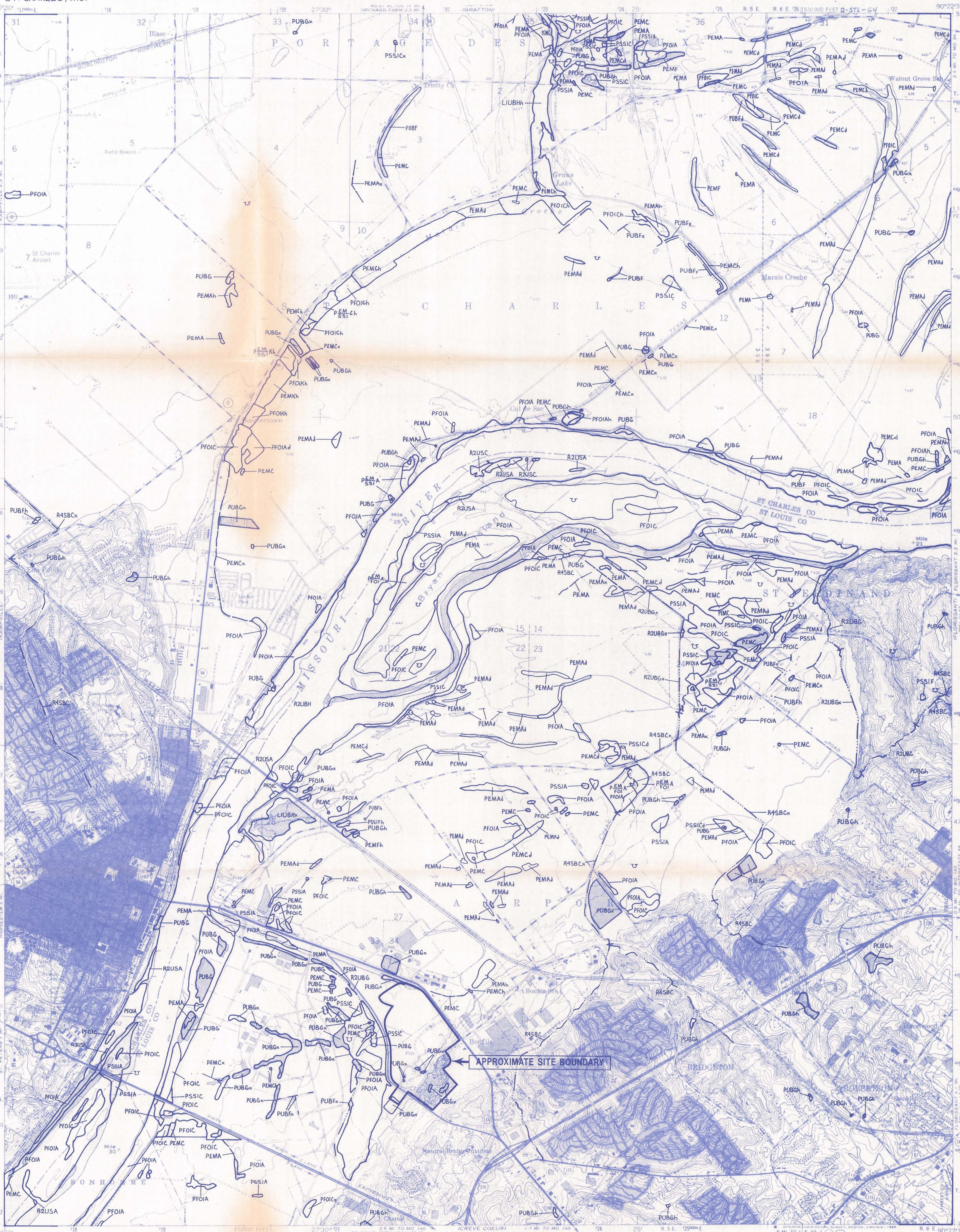
WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE

PERMITTED SURFACE WATER DISCHARGE POINTS

DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B017
REVIEWED	WEH	FILE NO.	2848B017	FIGURE NO.	2-11

ST. CHARLES, MO.



SAINT LOUIS NE
SAINT LOUIS

NATIONAL WETLANDS INVENTORY
UNITED STATES DEPARTMENT OF THE INTERIOR

ST. CHARLES, MO.

SCALE 1:24 000

1 MILE · 7000 FEET · 1 KILOMETER

1 acre · 10 acres · 20 acres
ACREAGE GUIDE

Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

Regional Director (ARDE) Region III
U.S. Fish and Wildlife Service
Federal Bldg., Ft. Snelling (AD/BSP)
Twin Cities, Minnesota 55111

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

SYMBOLOGY EXAMPLE

SYSTEM
SUBSYSTEM
CLASS
L2EM2F
SUBCLASS, WATER REGIME
UPLAND (NON-WETLAND)
R2OWH
(LINEAR DEEPWATER HABITAT)

ʊ — Primarily represents **upland** areas, but may include unclassified wetlands such as man-modified areas, non photo-identifiable areas and/or unintentional omissions.

NOTES TO THE USER
- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *Italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

AERIAL PHOTOGRAPHY

DATE: 3/ /85 · SCALE: 1:58 000 · TYPE: CIR
DATE: / / · SCALE: · TYPE:

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Prepared by National Wetlands Inventory
Base map provided by the United States Geological Survey.

1993

M — MARINE

SUBSYSTEM 1 — SUBTIDAL
- RB — ROCK BOTTOM: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED: 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
- RF — REEF: 1 Coral, 3 Worm
- OW — *OPEN WATER/Unknown Bottom*

SUBSYSTEM 2 — INTERTIDAL
- AB — AQUATIC BED: 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
- RF — REEF: 1 Coral, 3 Worm
- RS — ROCKY SHORE: 1 Bedrock, 2 Rubble
- US — UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic

E — ESTUARINE

SUBSYSTEM 1 — SUBTIDAL
- RB — ROCK BOTTOM: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED: 1 Algal, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- RF — REEF: 2 Mollusc, 3 Worm
- OW — *OPEN WATER/Unknown Bottom*

SUBSYSTEM 2 — INTERTIDAL
- AB — AQUATIC BED: 1 Algal, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- RF — REEF: 2 Mollusc, 3 Worm
- SB — STREAMBED: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- RS — ROCKY SHORE: 1 Bedrock, 2 Rubble
- US — UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- EM — EMERGENT: 1 Persistent, 2 Nonpersistent
- SS — SCRUB-SHRUB: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*
- FO — FORESTED: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*

R — RIVERINE

SUBSYSTEM: 1 — TIDAL · 2 — LOWER PERENNIAL · 3 — UPPER PERENNIAL · 4 — INTERMITTENT · 5 — UNKNOWN PERENNIAL

- RB — ROCK: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- *SB — STREAMBED: 1 Bedrock, 2 Rubble, 3 Cobble Gravel, 4 Sand, 5 Mud, 6 Organic, 7 Vegetated
- AB — AQUATIC BED: 1 Algal, 2 Aquatic Moss, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- RS — ROCKY SHORE: 1 Bedrock, 2 Rubble
- US — UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic, 5 Vegetated
- **EM — EMERGENT: 2 Nonpersistent
- OW — *OPEN WATER/Unknown Bottom*

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.
**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.

L — LACUSTRINE

SUBSYSTEM 1 — LIMNETIC
- RB — ROCK BOTTOM: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED: 1 Algal, 2 Aquatic Moss, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- OW — *OPEN WATER/Unknown Bottom*

SUBSYSTEM 2 — LITTORAL
- RB — ROCK BOTTOM: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED: 1 Algal, 2 Aquatic Moss, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- RS — ROCKY SHORE: 1 Bedrock, 2 Rubble
- US — UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic, 5 Vegetated
- EM — EMERGENT: 2 Nonpersistent
- OW — *OPEN WATER/Unknown Bottom*

P — PALUSTRINE

- RB — ROCK BOTTOM: 1 Bedrock, 2 Rubble
- UB — UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
- AB — AQUATIC BED: 1 Algal, 2 Aquatic Moss, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
- US — UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic, 5 Vegetated
- ML — MOSS-LICHEN: 1 Moss, 2 Lichen
- EM — EMERGENT: 1 Persistent, 2 Nonpersistent
- SS — SCRUB-SHRUB: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*
- FO — FORESTED: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*
- OW — *OPEN WATER/Unknown Bottom*

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal:
A Temporarily Flooded; B Saturated; C Seasonally Flooded; D *Seasonally Flooded/Well Drained*; E *Seasonally Flooded/Saturated*; F Semipermanently Flooded; G Intermittently Exposed; H Permanently Flooded; J Intermittently Flooded; K Artificially Flooded; W Intermittently Flooded/Temporary; Y Saturated/Semipermanent/Seasonal; Z Intermittently Exposed/Permanent; U *Unknown*

Tidal:
K *Artificially Flooded*; L Subtidal; M Irregularly Exposed; N Regularly Flooded; P Irregularly Flooded; *S Temporary-Tidal; *R Seasonal-Tidal; *T Semipermanent-Tidal; *V Permanent-Tidal; U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems

WATER CHEMISTRY

Coastal Halinity: 1 Hyperhaline; 2 Euhaline; 3 Mixohaline *(Brackish)*; 4 Polyhaline; 5 Mesohaline; 6 Oligohaline; 0 Fresh

Inland Salinity: 7 Hypersaline; 8 Eusaline; 9 Mixosaline; 0 Fresh

pH Modifiers for all Fresh Water: a Acid; t Circumneutral; i Alkaline

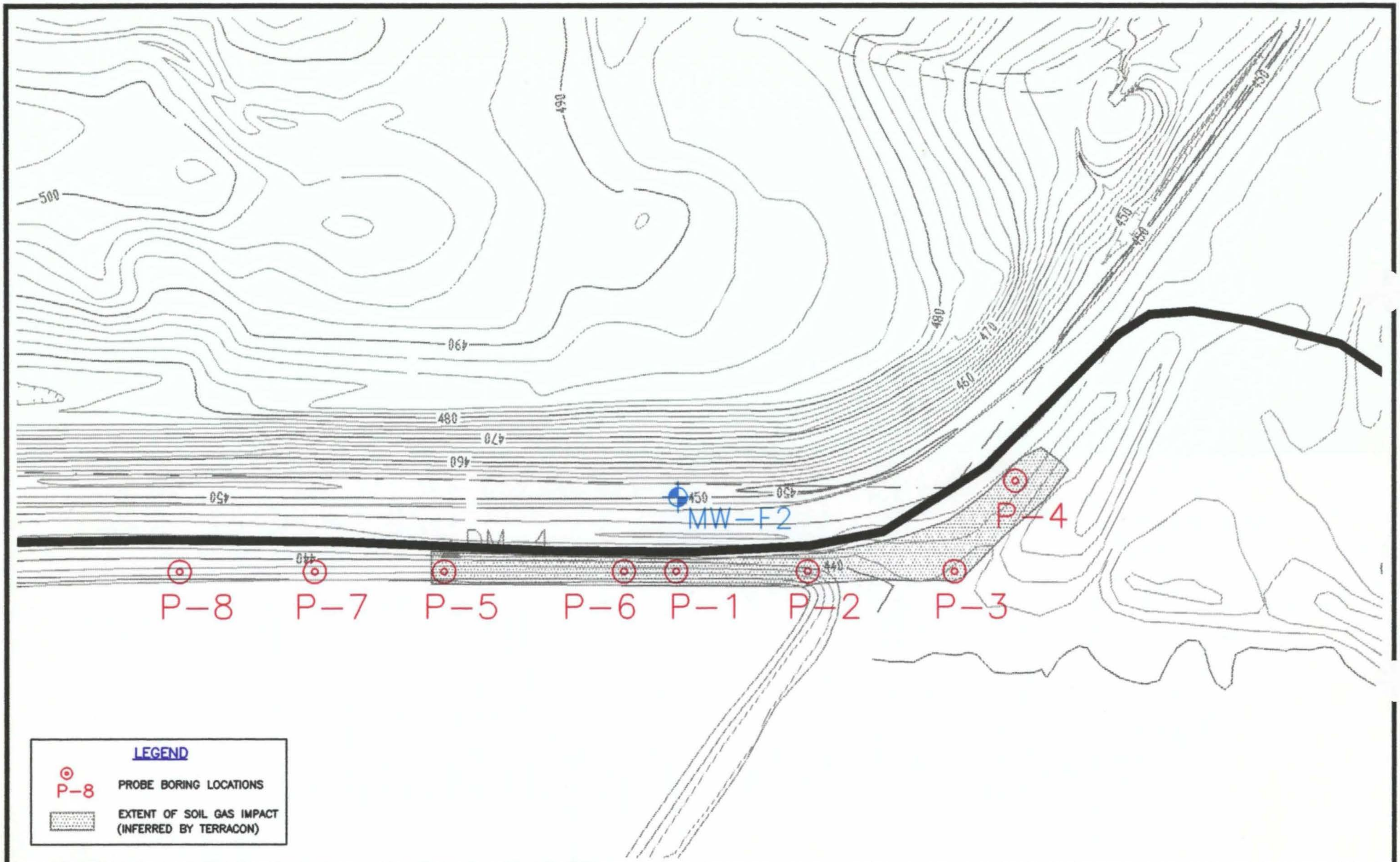
SOIL

g Organic; n Mineral

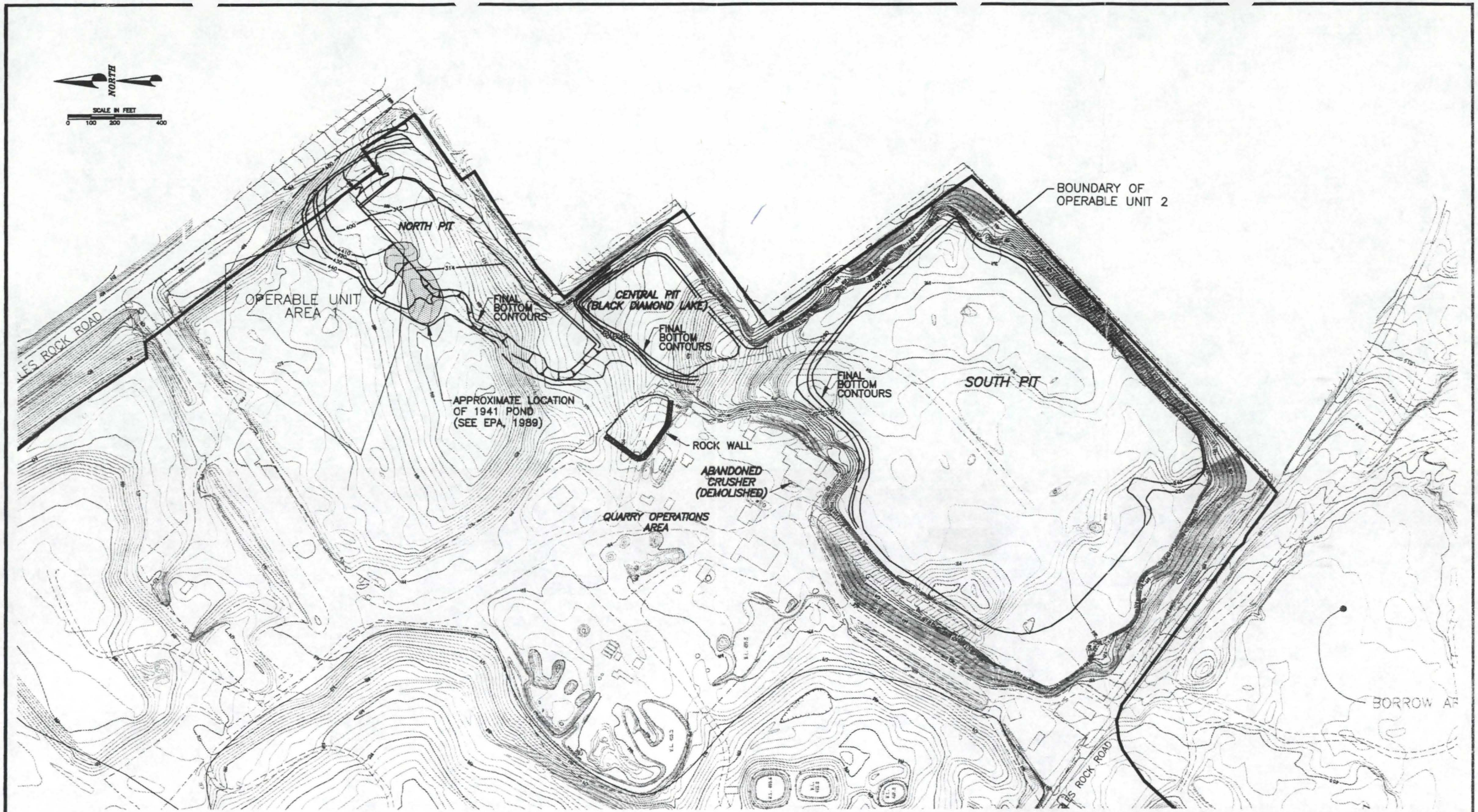
SPECIAL MODIFIERS

b *Beaver*; d *Partially Drained/Ditched*; f Farmed; h *Diked/Impounded*; r Artificial Substrate; s *Spoil*; x Excavated

Golder Associates, Denver, Colorado	TITLE: WETLANDS INVENTORY
CLIENT/PROJECT: LAIDLAW — LAIDLAW WASTE SYSTEMS INC. — Bridgeton Sanitary Landfill	DRAWN: BDL · DATE: APRIL 1995 · JOB NO. 943-2848.101
	CHECKED: CER · SCALE: · DWG. NO./REV. NO.
	REVIEWED: WEH · FILE NO. · FIGURE NO. 2-12

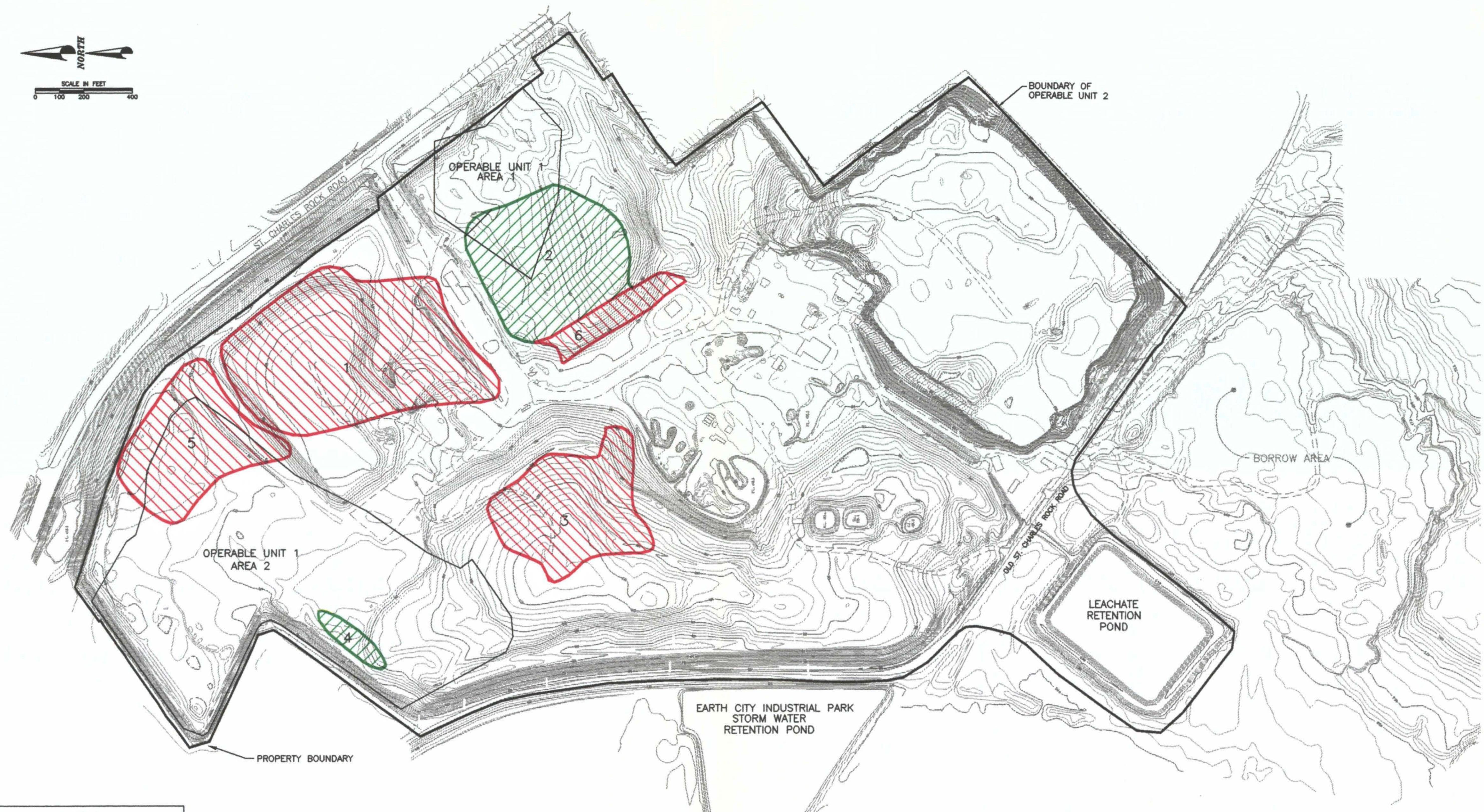


CLIENT/PROJECT		TITLE
LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2	Golder Associates DENVER, COLORADO	1991 SOIL GAS SURVEY NEAR MONITORING WELL MW-F2
DRAWN TMC / CHECKED CER / REVIEWED WEH	DATE APRIL 1995 / SCALE NOT TO SCALE / FILE NO. 2848A052	JOB NO. 943-2848 / DWG NO./REV.NO. A052 / FIGURE 2-13



SOURCE: *PERMIT CONSOLIDATION ENGINEERING REPORT, DRAFT:* MIDWEST ENVIRONMENTAL CONSULTANTS, P.C. OCTOBER 1994

Golder Associates	Denver, Colorado	TITLE **QUARRY PITS AND OPERATIONS**	
CLIENT/PROJECT LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995
		CHECKED CER	SCALE AS SHOWN
		REVIEWED WEH	FILE NO. 2848B010
		JOB NO. 943-2848	DWG. NO./REV. NO. B010
		FIGURE NO. **2-14**	



LEGEND

PRE-MDNR REGULATED LANDFILL AREA CLOSED IN 1974

PRE-MDNR REGULATED LANDFILL AREA PERMITTED BY THE MDNR SUBSEQUENT TO 1974

SOURCE: *AREA MAP*, THE ELBRING COMPANY, 1973

Golder Associates

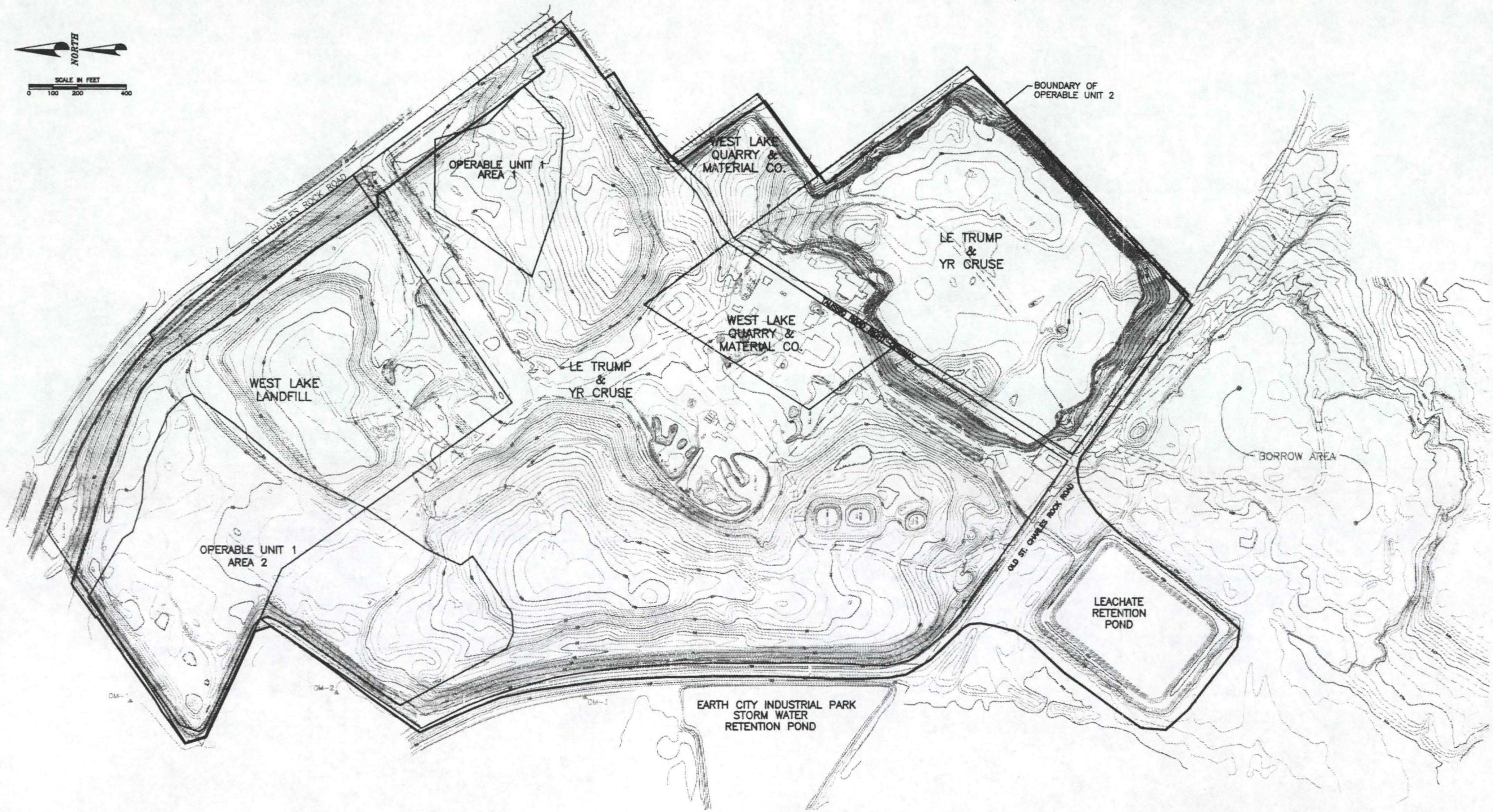
Denver, Colorado

TITLE	PRE-MDNR REGULATED LANDFILL AREAS				
DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B028
REVIEWED	WEH	FILE NO.	2848B028	FIGURE NO.	2-15

CLIENT/PROJECT

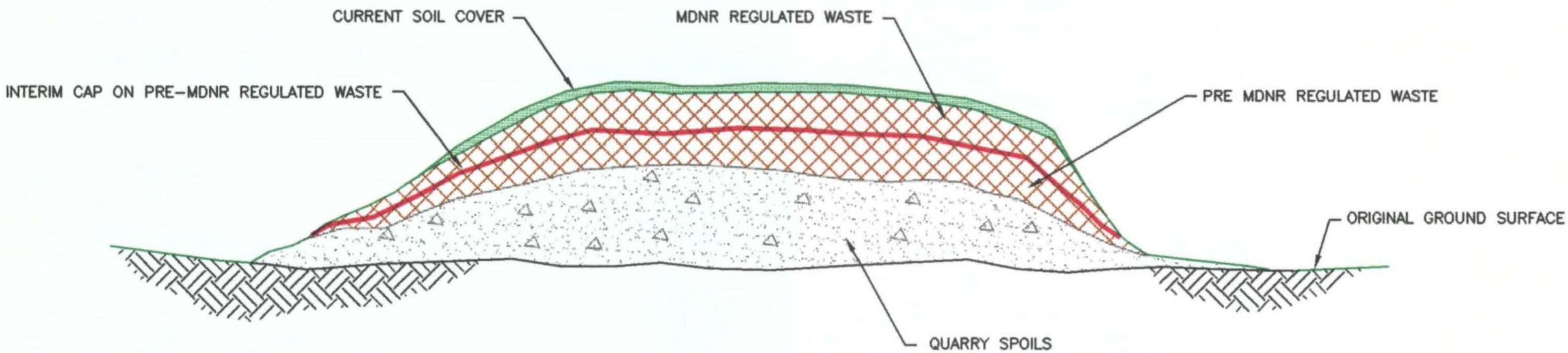
LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL OPERABLE UNIT 2

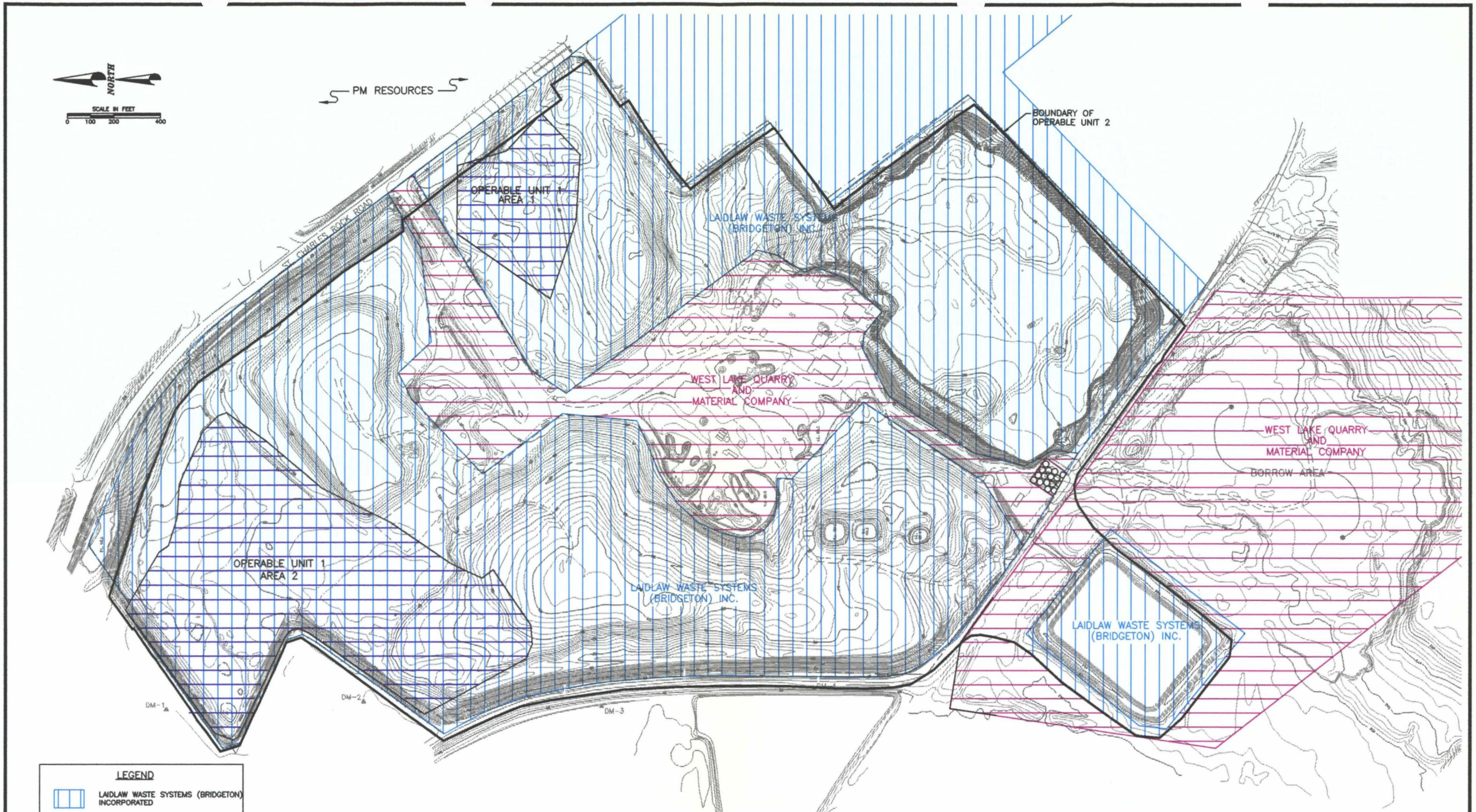


TOPOGRAPHY NORTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1994
TOPOGRAPHY SOUTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1992

Golder Associates Denver, Colorado	TITLE 1973 SITE OWNERSHIP MAP			
CLIENT/PROJECT LAIDLAW WASTE SYSTEMS INC. WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995	JOB NO. 943-2848	
	CHECKED CER	SCALE AS SHOWN	DWG. NO./REV. NO. B019	
	REVIEWED WEH	FILE NO. 2848B019	FIGURE NO. 2-16	



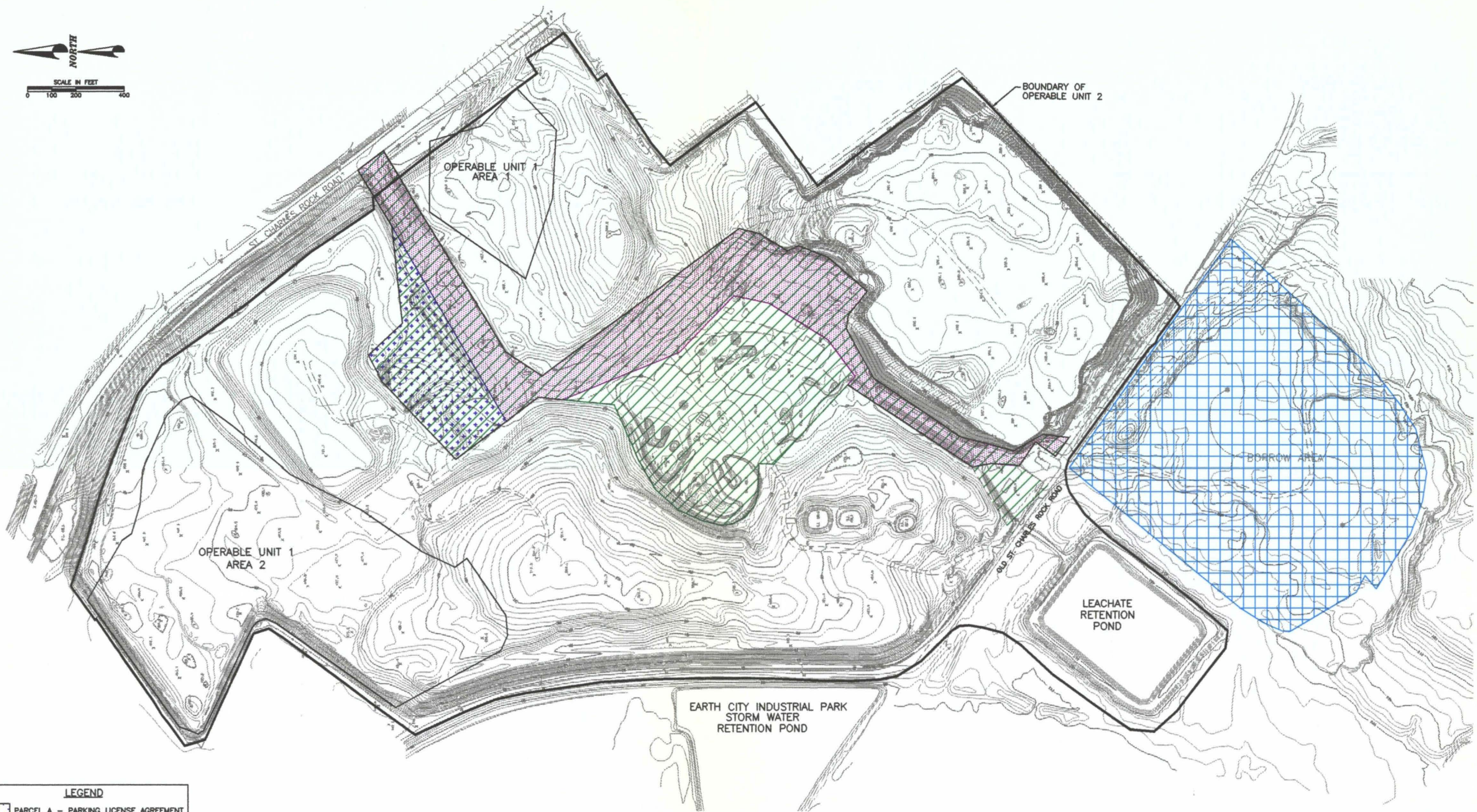
CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2			Golder Associates DENVER, COLORADO			TITLE: CONCEPTUAL WASTE DISPOSAL SEQUENCE AT THE INACTIVE LANDFILL AREA		
DRAWN TMC	CHECKED CER	REVIEWED WEH	DATE APRIL 1995	SCALE NOT TO SCALE	FILE NO. 2848A053	JOB NO. 943-2848	DWG NO./REV.NO. A053	FIGURE 2-17



SOURCE: LAIDLAW WASTE SYSTEMS, INC.

TOPOGRAPHY NORTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1994
TOPOGRAPHY SOUTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1992

Golder Associates	Denver, Colorado	TITLE CURRENT OPERABLE UNIT 2 SITE OWNERSHIP MAP		
CLIENT/PROJECT LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995	JOB NO. 943-2848
		CHECKED CER	SCALE AS SHOWN	DWG. NO./REV. NO. B021
		REVIEWED WEH	FILE NO. 2848B021	FIGURE NO. 2-18



LEGEND

- PARCEL A – PARKING LICENSE AGREEMENT AND TRAVEL LICENSE AGREEMENT
- PARCEL B & C TRACT – OPERATING/ REMOVAL LICENSE AGREEMENT
- GAS AND WELL MONITORING AREA – MONITORING LICENSE AGREEMENT
- WELLS/PROBES AREA – MONITORING LICENSE AGREEMENT

TOPOGRAPHY NORTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1994

TOPOGRAPHY SOUTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1992

SOURCE: LAIDLAW WASTE SYSTEMS, INC.

Golder Associates — Denver, Colorado

TITLE

LICENSE AGREEMENT AREAS

CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2

DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B007
REVIEWED	WEH	FILE NO.	2848B007	FIGURE NO.	2-19

LEGEND

- LEACHATE COLLECTION WELL (LCW)
- LEACHATE COLLECTION SUMP (LCS)
- ABANDONED COLLECTION AND PIT DEWATERING WELL
- ABANDONED LEACHATE COLLECTION WELL

SOURCE: MIDWEST ENVIRONMENTAL, 1994

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL
OPERABLE UNIT 2

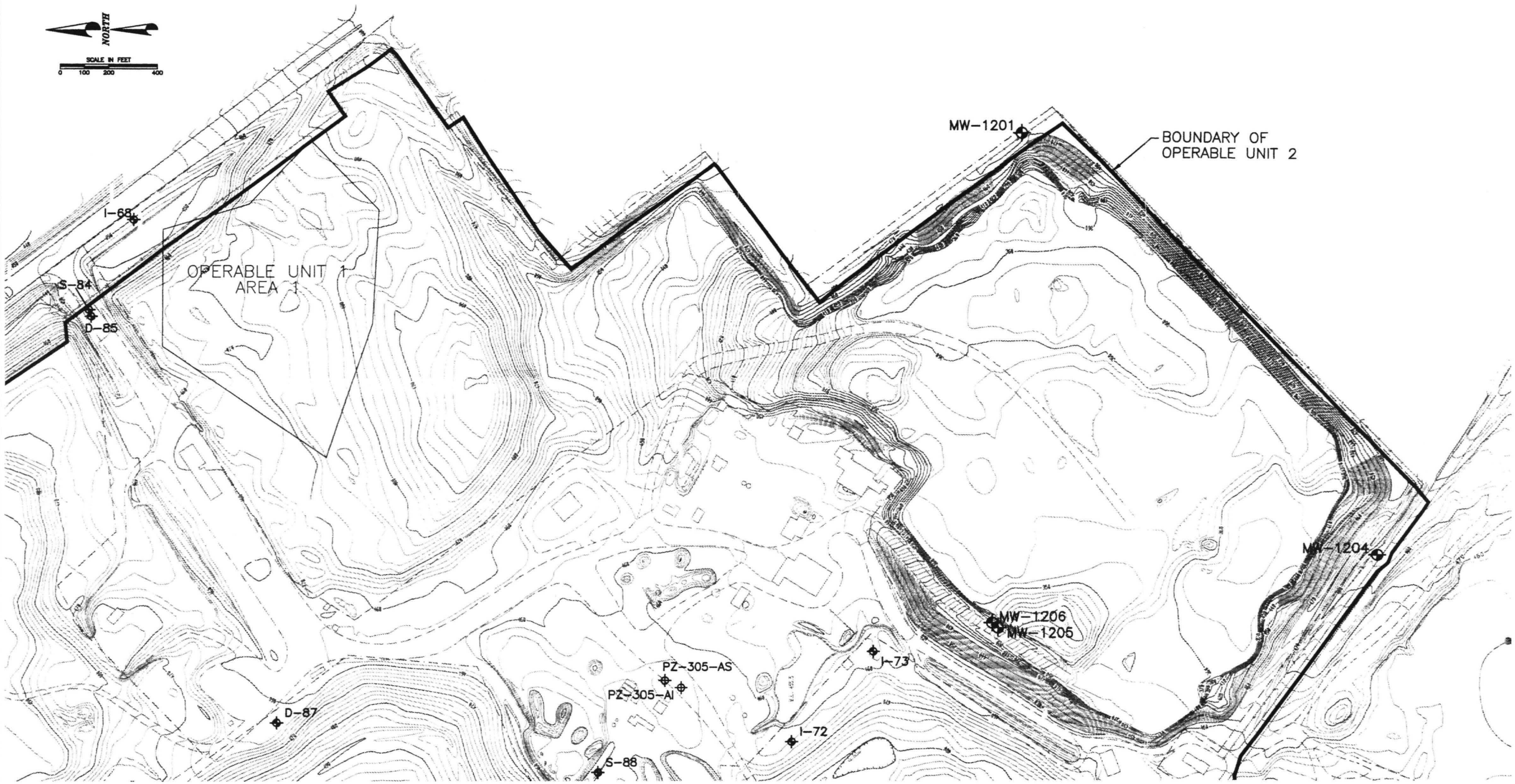
TITLE

LEACHATE COLLECTION SYSTEM

Golder Associates
Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D011
FILE NO.	2848D011	FIGURE	2-20


BOUNDARY OF OPERABLE UNIT 2
OPERABLE UNIT 1 AREA 1
TO BLOWER/ FLARE STATION
TO TRENCH ROCK WELLS (TRW)
12" HEADER
ELECTRICAL CONTROL PANELS
BLOWER/FLARE STATION
W-1
W-2
W-3
W-4
W-5
W-6
W-7
W-8
W-9
W-10
TRW-1
TRW-2
CD-7 TRW-3
TRW-4
TRW-5
TRW-6
TRW-7
TRW-8
TRW-9
CONDENSATE DRAIN LCS-3
GC-1
CONDENSATE DRAIN CD-3
LCS-1 CONDENSATE DRAIN
GC-2
CD-4 CONDENSATE DRAIN
WELLHEAD 6" RISER
CD-2 CONDENSATE DRAIN
CD-5 CONDENSATE DRAIN
LCS-2
GC-3
ABOVE GRADE HEADER PIPING TO BE REMOVED OR INSTALLED PER LANDFILL FILLING/PHASING OPERATIONS. AT LEAST ONE SIDE OF THE HEADER SHOULD BE CONNECTED AT ANY ONE TIME.
CD-1
LCS-4 CONDENSATE DRAIN
GC-4 CONDENSATE DRAIN
LEGEND
W-10 GAS EXTRACTION WELL
LCS-2 LEACHATE COLLECTION SUMP
GC-4 GAS COLLECTION MANHOLE
CD-1 CONDENSATE DRAIN
TRW-1 TRENCH HEADER CONNECTION
TRW-5 TRENCH ROCK WELL
INLINE VALVE
REDUCER
FLANGE
FLANGE WITH BLIND FLANGE
GAS COLLECTION HEADER
GAS COLLECTION TRENCH
EXISTING GAS COLLECTION TRENCH
ABOVE GROUND GAS COLLECTION HEADER
CONDENSATE DRAIN LINE
NORTH
SCALE IN FEET
0 50 100 200
SOURCE: RECORD CONSTRUCTION, WELL AND HEADER LAYOUT: WASTE ENERGY TECHNOLOGY, FEBRUARY 1993
REV. DATE DESCRIPTION DR. BY APP. BY
CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.
WEST LAKE LANDFILL OPERABLE UNIT 2
TITLE
LANDFILL GAS COLLECTION SYSTEM
Denver, Colorado
Golder Associates
DRAWN RLB
CHECKED CER
REVIEWED WEH
APPROVED
FILE NO. 2848D012
DATE APRIL 1995
SCALE AS SHOWN
JOB NO. 943-2848
DWG. NO. D012
FIGURE 2-21



LEGEND

MW-1206 CURRENT GROUNDWATER MONITORING PROGRAM WELLS

Golder Associates — Denver, Colorado

CLIENT/PROJECT: LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OU-2 RI/FS

TITLE: **CURRENT GROUNDWATER MONITORING PROGRAM WELLS**

DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B033
REVIEWED	WEH	FILE NO.	2848B033	FIGURE NO.	2-22

3.0 INITIAL EVALUATION

This section includes an evaluation of previous investigation results (Section 3.1), which provides the basis for an initial evaluation of potential source areas and the site characteristics (Section 3.2). The conceptual site model (Section 3.3) will guide the RI and will assist in the identification of potential remedial actions. The preliminary identification of state and federal applicable or relevant and appropriate regulations (Section 3.4) provides guidance on regulatory requirements for remediation of environmental media. Based on the conceptual site model and regulatory requirements, preliminary remedial action objectives (Section 3.5) are developed. The preliminary remedial action objectives are used to identify preliminary remedial action alternatives (Section 3.6).

3.1 Previous Investigation Evaluation

Previous investigations conducted at the site have investigated hydrogeologic characteristics and the extent of contamination in environmental media. These investigations are summarized in Section 2.3.6.1 and presented in Table 2-2. The following sections evaluate the results of the previous investigations by environmental media.

3.1.1 Soil and Sediment

Few soil and sediment samples collected during previous investigations have been analyzed for organic and inorganic chemical constituents. Soil samples collected during the Earth City industrial park investigations (Dames & Moore, 1990b and 1991) were analyzed for total petroleum hydrocarbons, pesticides, polychlorinated biphenyls, herbicides, cyanide, metals, and semivolatile organic compounds. These constituents were either not identified, identified at concentrations at or below background levels, or attributed to the sample collection technique. Analyses of soil samples collected from the OU-1 area by the NRC focused on radioactive materials based on the nature of the material reportedly disposed of at the site in 1973 (NRC, 1988). Priority pollutant analysis of soil samples detected chromium, copper, lead, nickel, and zinc. A leachate treatment pond sludge sample displayed lower priority pollutant concentrations than subsurface soil samples.

Radiological constituent soil and sediment sampling has been similarly limited. The Dames & Moore studies of the Earth City industrial park collected samples from two radiological "hot spots" adjacent to OU-1 Area 2. The samples were analyzed for gross alpha, gross beta, thorium-230, radium-226, uranium-234, and uranium-238 (Dames & Moore, 1990b and 1991). Concentrations of radionuclides above background levels were identified in these samples. The RMC studies of OU-1 identified elevated levels of uranium and/or thorium decay chain nuclides, and potassium-40 in soil samples (RMC, 1982). A survey of erosion from the berm west of OU-1 Area 2 identified radionuclide migration from the source material (ORAU, 1984).

The McLaren/Hart overland gamma survey identified slightly elevated gamma radiation extending west of OU-1 Area 1 to the site access road, and southwest of OU-1 Area 2 onto neighboring property (McLaren/Hart, 1994b), although all results are below health-based action levels. For completeness, McLaren/Hart recommended expansion of the OU-1 Area 1 to include the outlying radiological hot spot.

3.1.2 Groundwater

Groundwater sampling and analysis was conducted at the site as early as 1973, and has continued to date in various single and ongoing investigations summarized in Section 2.3.6.1. Groundwater samples have been collected by several different investigators and were analyzed for a variety of analytical suites, generally with unstated quality assurance/quality control (QA/QC) techniques.

Initial groundwater monitoring investigations were oriented towards the now inactive landfill area on the western portion of the site (Figure 2-4). Samples were typically analyzed for general inorganic parameters and metals. Some analyte lists included phenol or restricted metals analysis to iron. In 1980, samples were collected from temporary wells completed around the perimeter of the entire site. In 1981, wells completed around the leachate retention pond were included in the groundwater monitoring program.

Extended analyte lists were used for three separate investigations. A 1983 investigation of wells completed around the site perimeter analyzed samples for general inorganic parameters, metals, and pesticides (Reitz & Jens, Jan. 3, 1984). An extensive investigation of the inactive landfill area was conducted by Burns & McDonnell in 1985 and 1986. The analyte list for this investigation included metals, volatile organic compounds, pesticides, polychlorinated biphenyls, acid/base neutral extractables, total phenols, and total cyanide (Burns & McDonnell, 1986). In 1990, a site-wide investigation conducted by Environmental Analysis Inc. included the following analytes: general inorganic parameters, metals, volatile organic compounds, pesticides, herbicides, PCBs, cyanide, and phenol (Environmental Analysis, Oct. 4, 1990, Oct. 10, 1990, Nov. 1, 1990, and Dec. 1, 1990, and York, Oct. 4, 1990).

Investigations of radiological constituents in groundwater were generally oriented towards OU-1, although some site-wide investigations have also included radiological constituents in parameter lists. Investigations conducted in 1980 (MDNR, Oct. 8, 1980), 1983 (Reitz & Jens, Jan. 3, 1984), 1985 and 1986 (Burns & McDonnell, 1986), and 1990 (York, Oct. 4, 1990) included analysis and detection of radionuclides in excess of drinking water standards in groundwater downgradient and cross-gradient of the site. Recent sampling suggests that radioactivity in groundwater is regionally elevated. The RI data will be used to more completely characterize upgradient radionuclide concentrations.

3.1.3 Surface Water

Surface water samples were collected in 1980 from a surface water body in the quarry and a small slough north of the site (MDNR, Jan. 5, 1981) (Figure 2-4). The samples were analyzed for biological oxygen demand, chemical oxygen demand, cations, anions, and total metals; concentrations of these parameters in the quarry lake samples were elevated compared to the slough samples.

3.1.4 Leachate

Chemical analysis of leachate has been conducted since the initiation of leachate collection in 1978. As described in Section 2.6.2, leachate was initially pumped to an above ground holding tank for transport to the Metropolitan St. Louis Sewer District (MSD) (West Lake Quarry and Material Co., Jan. 11, 1979). A leachate treatment system was then developed, for direct discharge to the MSD system. Samples of leachate have been collected both upstream and downstream of the treatment system (Environment Energy Consultants, Sept. 9, 1982). Leachate samples have been analyzed for general inorganic parameters, metals, grease, phenol, chemical and biological oxygen demand (COD and BOD), pesticides, herbicides, and radionuclides. Concentrations of these parameters are within the typical range for leachate by the EPA (EPA, 1991e).

3.1.5 Vegetation

A vegetation analysis was conducted as part of the *Radiological Survey of the West Lake Landfill* (RMC, 1982). Weed samples from on site locations and farm crop samples (winter wheat) from the northwest boundary of the landfill were analyzed for the presence of chemical constituents. The analyses showed no elevated radiological activity in these samples.

3.1.6 Air

Samples collected directly from the landfill gas collection system have been analyzed for compounds including oxygen, nitrogen, carbon dioxide, hydrogen sulfide, and methane. Analytical results of these samples compare favorably with typical landfill gas compositions collected by EPA (EPA, 1991e).

Air samples from site and nearby off-site locations were collected and analyzed for the presence of radon daughter products for the *Preliminary Health Assessment for West Lake Landfill* (ATSDR, 1991). A 1992 investigation of the site for the development of a site health and safety plan also collected and analyzed air samples for radon daughter products (Wester, 1992a). Samples were collected from the landfill gas collection system and the landfill cover surface. A landfill surface survey of OU-1 and follow-up gas collection assessment conducted in 1993 also analyzed air samples for radon daughter products (Golder, 1993a). Each of these investigations identified detectable levels of radon daughter products, but concluded that risks to on-site workers and the general public were minimal.

An assessment of chemical constituents in landfill gas was conducted in 1993 and 1994 (Golder, 1994). Samples were collected from two gas collection system points, and analyzed for volatile organic compounds, fixed gases and sulfur compounds, aliphatic amines, and aldehydes. The composition of the landfill gas was determined to be typical for municipal solid waste facilities. Site workers were also fitted with personal air samplers and tested for volatile organic compounds and fixed gases; personal air samplers did not identify detectable levels of these constituents.

3.2 Potential Source Areas

The following sections discuss potential sources areas at the West Lake Landfill, including solid waste, liquid waste, hazardous waste, radioactive waste, and underground storage tanks. A discussion of potential chemicals of concern concludes this section.

The leachate retention pond is associated with the active, regulated, solid waste landfill and has reportedly not received hazardous liquids. Consequently, at this juncture the leachate retention pond will not be considered a likely source. Additionally, some maps show a surface water feature in the quarry landfill. The surface water feature is ephemeral, based on precipitation and run-on into the landfill, and its location depends on changing landfill contours. It is therefore not a permanent surface water feature or potential source of ecological interest.

3.2.1 Solid Waste

The West Lake Landfill has accepted solid waste since at least 1962 and possibly as early as 1952. Pre-MDNR waste disposal at the site may have included industrial, municipal, and demolition wastes. MDNR-regulated waste disposal, starting in 1974, is reported to include only demolition and sanitary wastes.

The areas of the site addressed by this Work Plan include inactive landfill areas filled with unspecified, industrial, sanitary, and demolition wastes, as well as the active landfills filled with sanitary and demolition wastes. The inactive landfill portion of the site includes areas of pre-MDNR and MDNR-regulated waste disposal on mine spoils and in the north quarry pit.

The active permitted sanitary landfill (Permit # 118912) includes the eastern portion of the north quarry pit, the central pit, and the south pit. The north and central pits are not currently being filled; active sanitary landfilling is currently in the south pit.

Available information indicates that pre-MDNR waste disposal did not occur within the central and south pits (Figure 2-14 and 2-16). Pre-MDNR waste disposal also did not occur within the north pit; however, the 118912 permit area extends about 200 feet beyond the limits of north pit quarrying (Figure 2-17).

Historical aerial photographs indicate that standing liquids were periodically present in the north pit area (EPA, 1989d). There is no documentation to indicate that these liquids were liquid wastes. The liquids are just as likely stormwater runoff accumulation and/or the result of quarry pit dewatering.

The inactive landfill area includes the highest elevation at the site (513.4 feet MSL). Undisturbed ground surface elevation ranges from about 450 feet MSL to about 485 feet MSL. Wastes disposed in the inactive portion of the landfill likely range from about 450 feet MSL to 510 feet MSL; the refuse thickness is therefore a maximum of about 60 feet. Permit documents for MDNR-regulated waste disposal on top of pre-MDNR waste disposal in the 118903 permit area indicate a base grade of about 460 feet MSL. Therefore, the elevation of pre-MDNR waste disposal in the inactive landfill is from about 450 to 460 feet MSL; thickness of pre-MDNR waste is a maximum of about 10 feet.

Pre-MDNR waste disposal areas are also present in the northwestern portion of the MDNR-regulated sanitary landfill, as discussed above. Ground surface contours in the area of pre-MDNR waste disposal are approximately 440 feet MSL, based on quarry pit records (Figure 2-14), compared to undisturbed ground surface elevations of about 460 feet MSL. Current ground surface elevation in this area is a maximum of 500 feet, indicating a potential refuse thickness of about 60 feet. There is no information available to allow for an estimation of pre-MDNR waste thickness in this area.

Leachate generated by water percolating through the landfilled areas may cause groundwater contamination if not properly collected and controlled. Leachate is controlled within the southern portion of the active sanitary landfill area by a leachate collection system. The system is intended to maintain an inward flow of groundwater towards the active landfill area. The system pumps collected leachate to a synthetic-lined leachate retention pond for treatment and subsequent discharge to the MSD sewer system. There is no leachate recovery within the inactive landfill areas or the active demolition landfill.

Landfill gases are generated by the decomposition of solid wastes within landfilled areas. Landfill gas generation within the active sanitary landfill is controlled with a gas collection system, which includes recovery wells, a blower, and flare to burn collected gases. There is no landfill gas collection system within the inactive portion of the landfill.

3.2.2 Liquid Waste

Liquid waste disposal is currently prohibited at the site. However, historical information indicates that liquid waste may have been disposed of in the inactive landfill between 1958 and 1971 (EPA, 1989d). Potential liquid waste disposal areas appear to be restricted primarily to the north end of the inactive landfill area (southern extent of OU-1 Area 2) and the center of the inactive landfill area (Figure 2-8). Ponds within the quarry operations area were likely associated with limestone processing and were likely not associated with liquid waste disposal.

3.2.3 Hazardous Waste

Complete characterization of wastes at the site has not yet been performed. As discussed in Section 2.5.3.2, industrial wastes were deposited at the site between 1969 and 1979. These wastes were apparently disposed of either in pre-MDNR regulated or in unpermitted areas. Available information indicates the disposal of the following industrial wastes:

- Paints and pigments (unknown quantity) by Borden Chemical Company;
- Insecticides, herbicides, fungicides, intermediates, and non-polar solvents (4,000 tons) by Chevron Chemical Company;
- Insecticides and shock sensitive wastes (1,100 tons) by Olin Corporation; and,
- Unspecified heavy metals and inorganic wastes (2,100 tons) by Pfizer, Inc.

3.2.4 Radioactive Waste

Radioactive wastes have apparently not been disposed of within the area of the site comprising OU-2. However, available information indicates that in 1973 approximately 8,700 tons of leached barium sulfate ($BaSO_4$) residues, containing approximately 7 tons of uranium, was mixed with approximately 39,000 tons of soil and deposited at the site within the area now comprising OU-1 (McLaren/Hart, 1994). The proximity of OU-1 to OU-2 increases the potential for radioactive waste deposited in OU-1 to contaminate OU-2 environmental media, as described below. The potential for radioactive contaminant migration via groundwater will be investigated as part of the OU-2 RI; migration via soils is anticipated to be limited in areal extent and will be addressed by the OU-1 RI.

Groundwater

Selected groundwater samples have been analyzed for the presence of radioactive isomers. Samples collected from the perimeter of the inactive landfill in 1986 identified low concentrations of gross alpha and gross beta in almost all locations (Burns & McDonnell, 1986). Highest concentrations were reported for piezometers downgradient or cross gradient from OU-1 areas. Sampling and analysis for radiological contamination in groundwater in the adjacent Earth City industrial park identified no radionuclides above background levels in filtered groundwater samples (Dames & Moore, 1990b).

Soil

Available information indicates that migration of radioactively-contaminated soils from OU-1 may have occurred. The *Survey for Berm Erosion* (ORAU, 1984) investigated the potential for erosion to transport radiologically-contaminated soils from the berm along the western border of OU-1 Area 2. The survey concluded that "erosion is occurring and that there are elevated concentrations of Ra-226 and Th-230 at the base of the berm and extending into the adjacent field."

The Dames & Moore (1990b) investigation of the adjacent Earth City industrial park similarly identified elevated concentrations of radiologically contaminated soils near OU-1 Area 2. In two sample locations, gross alpha and gross beta levels exceeded background levels by factors of 55 to 200 and 10.6 to 31, respectively. Radioisotopes (U-234, U-238, Th-230, Th-232, and Ra-226) ranged from 3 to over 900 times background concentrations as defined by their investigation.

A recent walkover gamma survey of OU-2 (McLaren/Hart, 1994b) identified radiological "hot spots" outside the current boundaries of OU-1 Areas 1 and 2, although all results were below health-based action levels. Near Area 1, a hot spot was identified southeast of the entrance station near an underground storage tank site. Hot spots were also identified south of Area 2, at the location of a historical slope failure and along the fence line at the property boundary. These results indicate a strong potential for migration of radiological contamination outside the boundaries of OU-1.

Air

Air samples from site and nearby off-site locations were collected and analyzed for the presence of radon daughter products for the *Preliminary Health Assessment for West Lake Landfill* (ATSDR, 1991). A 1992 investigation of the site for the development of a site health and safety plan also collected and analyzed air samples for radon daughter products (Wester, 1992a). Samples were collected from the landfill gas collection system and the landfill cover surface. A landfill surface survey of OU-1 and follow-up gas collection assessment conducted in 1993 also analyzed air samples for radon daughter products (Golder, 1993a). Ambient air samples collected during these investigations have identified radon or daughter products at or near background levels.

3.2.5 Underground Storage Tanks

Underground storage tanks (USTs) are known to be present, based on visual inspection, near the asphalt batch plant (Figure 2-4) operated by Red Bird Asphalt. The USTs likely store petroleum-based products in support of asphalt plant activities. Laidlaw site personnel have observed the installation of monitoring wells around the UST location, indicating that an UST investigation may be underway.

3.2.6 Potential Chemicals of Concern

Based on the above-listed potential contaminant sources, and the EPA *Administrative Order on Consent, Attachment II: RI/FS Statement of Work* (EPA, 1994b), the following types of potential chemicals of concern have been identified:

- Volatile and semivolatile organic compounds;
- Total petroleum hydrocarbons;
- Pesticides;
- Polychlorinated biphenyls;
- Metals;
- Cyanides; and,
- Radionuclides (in groundwater only).

Environmental media at the site have been tested for the presence of each of these analyte groups. However, inconsistent sampling and unknown QA/QC procedures have diminished the value of previous investigation results, and precise concentrations of these parameters within each media are not well established. This Work Plan will provide for assessment of actual conditions at the site.

Non-radioactive chemicals potentially present in groundwater at the site were identified based on sampling performed by Burns & McDonnell in 1985 and 1986 (Burns & McDonnell, 1986). Significant priority pollutant contamination in soils or groundwater has not been indicated. Analytical results have generally been inconclusive, since the distribution of these contaminants has been scattered, irregular, and occasionally suggestive of laboratory contamination. Organic chemicals that have been detected include methylene chloride, phenol, acetone, hexachlorobenzene, and bis (2-ethylhexyl) phthalate (some of which are laboratory contaminants, and were detected in laboratory blank samples during previous investigations) (McLaren/Hart, 1994a). Inorganic chemicals detected include antimony, arsenic, cyanide, iron, lead, nickel, sodium, thallium, and zinc. Total petroleum hydrocarbons (TPH) and chlorinated pesticides have also been detected.

3.3 Conceptual Site Model

3.3.1 Purpose

The conceptual site model (CSM) is a collection of hypotheses regarding the potential exposure pathways from chemical sources to receptors at or near the site. Receptors include both humans and identified ecological species or components (such as wetlands) of concern that are potentially exposed to site chemicals. The CSM identifies all potential chemical sources (described in Section 3.2), potentially exposed receptors, and exposure pathways for the site. Risk occurs only when all three elements are present. A graphic representation of risk components is provided in Figure 3-1.

For exposure to occur, the potential must exist for a receptor to come in direct contact with constituents released into the environment, or for released constituents to be transported through an environmental medium to a receptor. An exposure pathway includes the five necessary elements listed below:

- Source of chemicals;

- Mechanism of chemical release;
- Environmental transport medium (air, surface water, etc.);
- Exposure point where receptors are present; and,
- Intake (exposure) route (inhalation, ingestion, etc.).

Each these five elements must be present for an exposure pathway to be complete. Exposure pathways are considered to be potentially complete if there are chemical releases, transport mechanisms, and identified receptors for that exposure pathway. An incomplete pathway means that no exposure can occur. Only complete and potentially complete pathways are addressed in a risk assessment. Information concerning waste sources, waste constituent release and transport mechanisms, and locations of potentially exposed individuals (receptors) is used to develop a conceptual understanding of the site in terms of potential human or ecological exposure pathways.

The CSM is developed early in the process of site investigation. As additional information is collected, the model is modified to reflect new understanding of the site. The CSM guides the development of the exposure assessment portion of the risk assessment. The objectives of the exposure assessment are to identify receptor populations that may be exposed to contaminants of concern, the pathways by which exposure may occur, the route of intake and intake parameters for inhalation and ingestion for each potentially contaminated medium, and the estimated magnitude, frequency, and duration of the exposures that may occur at the exposure points. Sampling or other data needs may be identified as the CSM is developed.

EPA guidance (EPA, 1991e and 1993a) provides for special uses of the CSM as part of a streamlined risk assessment process for CERCLA municipal landfills (see Sections 3.3 and 3.4). The guidance recommends containment as the presumptive remedy for landfills. If there is a clear justification for taking remedial action at the site, then a streamlined risk assessment may be sufficient. In this case, risks from the source need not be evaluated since the evaluation will not change the remedy; however, risks due to chemical migration from the site still need to be evaluated. Conversely, if chemicals are detected at concentrations near the screening levels yet there is no clear need for action, a full risk assessment will be necessary to determine whether action is needed. (Note that EPA guidance provides no definition for "clear need.") The CSM is reviewed as the remedy is implemented to ensure that all potentially significant exposure pathways have been adequately addressed by the remedy.

3.3.2 Conceptual Site Model for the West Lake Landfill

The Conceptual Site Model for the West Lake Landfill provided in this Work Plan is preliminary and identifies only potential migration pathways. Sampling will provide information about whether migration has occurred along those potential pathways, allowing refinement of the CSM. Collected information will be compared to conservative screening concentrations and potential applicable or relevant and appropriate regulations (ARARs) such as Maximum Contaminant Levels (MCLs). If ARARs are clearly exceeded in areas where exposure is likely to occur, then remedial action may be taken without conducting a full risk assessment. The same is not true for conservative screening levels: exceeding screening levels such as EPA's Risk-Based Concentration (RBC) levels (EPA, 1994a) does not indicate a risk; instead, it indicates that a risk assessment is necessary. The RBCs, combined with the list of analytes described in Section 4.1, will be used as screening levels for this site. If conservative screening levels and MCLs are not exceeded, then any further action (including further detailed risk assessment) is not necessary.

3.3.3 Site History and Use

A complete description of the site history and land use is provided in Section 2.1. That description shows that the site has been used for commercial and industrial purposes. The only reasonable foreseeable future use for the site is as an industrial site. The State of Missouri and Federal RCRA Subtitle D Regulations restrict the use of closed landfills. Groundwater under or near the site is not used for drinking water, either by public water suppliers or by private users of domestic wells.

The site has three operating industrial facilities: an asphalt plant, a concrete plant, and the active solid waste landfill. The site also has one commercial facility: an automotive repair and body shop. The asphalt and concrete facilities have no unusual features that indicate a potential for health risk. Similarly, the active solid waste landfill has been operating under MDNR permits 118912 and 218912, which do not allow acceptance of hazardous wastes. Workers at these facilities are covered by appropriate OSHA Health and Safety plans. Under an agreement between OSHA and the EPA (OSHA-EPA, 1990), it is appropriate to apply OSHA regulations to workers at a CERCLA site. Laidlaw commissioned an investigation into emissions and worker exposure at the active solid waste landfill (Golder, 1994) which showed that both emissions and exposures are typical for landfills in the United States. Risk assessment methods under CERCLA for worker exposure assume that the workers have no knowledge of the presence of chemicals at the work site, have no safety training, and have no protection under OSHA. These assumptions do not apply in the operating industrial facilities at the West Lake Landfill.

Only source areas physically located in Operable Unit 2 (OU-2) are included in the CSM. Impacts on OU-2 from OU-1 will be addressed under the OU-1 risk assessment. Areas associated with the operating landfill, the asphalt plant, and the concrete plant will be excluded, as described above.

3.3.4 Potential Human Receptors, Exposure Points, and Exposure Pathways

In this section, different types of human receptors and their locations relative to the site are considered to identify potentially complete exposure pathways. Potential exposure pathways for human receptors are depicted in Figure 3-2.

As more data are collected, certain exposure pathways may be found implausible due to the absence of specific chemicals likely to migrate in groundwater, volatilize from soils, bioaccumulate, etc. At this preliminary stage, pathways will not be eliminated based on the type or quantity of chemical present; all pathways will be retained.

On-site Residents

There are no on-site residents, and future use of the site for residential purposes will not occur because of MDNR regulations, state and federal deed requirements, and recent court decisions. Use of groundwater as a drinking water source is extremely unlikely. Residential developments near the site are served by a public water system. Consistent with EPA guidance, on-site residential use will not be considered further in the CSM.

Off-Site Residents

There are no adjacent residential areas. The current use of adjacent sites is industrial only. Hypothetical, future nearby off-site residential use is improbable, based on current zoning, and a recent State of Missouri Court decision. For the purpose of the CSM, future off-site residents are assumed to reside in the same approximate locations as current residents. At the present, the closest residential areas are:

- Spanish Lake Village, 1.5 km (0.9 miles) south of the landfill (90 homes); and,
- A trailer court, 1.5 km (0.9 miles) southeast of the site.

These residential areas are located hydraulically upgradient of the site. Population density is 26 persons per square mile (ATSDR, 1991).

Hypothetical future nearby off-site residents would be unlikely to use groundwater as the domestic drinking water source. While some private wells (approximately one mile or more from the site) may be used for domestic and irrigation purposes, four such wells have been monitored by the Missouri Department of Health (1990) and have shown no radionuclide or pesticide detections. The potential for chemical migration offsite in groundwater will be evaluated from a risk perspective only if there is a reasonable probability of using the groundwater in the future. Depending on chemicals predicted to be present, ingestion, dermal contact, and inhalation exposures may be evaluated.

The presumptive remedy prevents exposure to leachate through leachate collection and treatment (EPA, 1993a). Therefore, the sources of potentially impacted groundwater are existing groundwater plumes or leachate from areas of the landfill that are not collected by the leachate collection system.

Chemicals may migrate offsite via the air. However, the presumptive remedy prevents exposure to landfill gas through gas collection and treatment, and the landfill cap will prevent fugitive dust emissions. Therefore, the remaining source of airborne chemicals is gas emission from areas of the landfill that are not collected by the gas collection system. It is expected that, given the large distance to the residential population, such emissions would have a negligible impact. Site investigation sampling will identify chemical sources that have the potential to release significant amounts of gas. Until this information is collected, inhalation of landfill gas by off-site residents will be retained as a pathway to be evaluated.

On-Site Workers

Currently available information (Golder, 1993 and 1994) shows that worker exposures via multiple pathways are below acceptable limits for workers. This conclusion is based on estimates of airborne emissions related to the gas collection system and radon emanation, exposure to radionuclides associated with the leachate collection system, and external radiation exposure. While these pathways are likely to represent the most significant exposures by on-site workers, there are additional potential pathways that have not been previously investigated (see Figure 3-2). Leachate associated with inactive areas of the landfill represents a potential source because it would not be collected by the existing leachate collection system. This leachate may seep onto surface soils or into surface waters, or groundwater impacted by leachate could be released to surface waters. Therefore, on-site workers will be evaluated for dermal exposure and incidental ingestion of surface soil and water.

It is unlikely that groundwater will be used as a drinking water source for on-site workers. Direct exposure by workers to potentially impacted groundwater is likely to occur only in relation to remedial actions, with knowledge of the potentially impacted water and the use of protective equipment. Therefore, direct worker exposure to potentially impacted groundwater will not be evaluated.

Gas emissions from inactive areas of the landfill represent a potential source of airborne chemicals. Workers will be evaluated for inhalation of these gases.

The presumptive remedy eliminates several exposure pathways and, as a result, these pathways will not be evaluated in this report. These are: inhalation of fugitive dust, incidental ingestion of soils (other than soil exposure described above), and exposures to leachate and gas from the active landfill areas (which are prevented by collection systems).

Future industrial activities at the site are subject to OSHA requirements These requirements ensure that future workers are aware of potential chemical exposures. Workers must be made aware of the chemicals they contact as part of their job. These workers are protected under OSHA health and safety plans; such exposures need not be evaluated using CERCLA risk assessment methods or criteria.

Off-Site Workers

The exposure potential for off-site workers is lower than for on-site workers. Accordingly, if there is no unacceptable risk to on-site workers, there will be no unacceptable risk to off-site workers. If calculated risks for on-site workers indicate a need for remedial action, such action will further reduce any potential risks to off-site workers as well. Therefore, as long as risks to on-site workers are quantitatively evaluated, there should be no need to conduct a separate evaluation for off-site workers.

Off-Site Recreational Receptors

The most likely public receptors adjacent to the landfill are those engaging in recreational activities. There is evidence of fishing in the north slough (Figure 2-4). Potential reclamation of the landfill and surrounding areas may result in increased future recreational use. While the north slough is a likely point of exposure, it will be evaluated in the RI/FS for OU-1, and is not addressed by the OU-2 RI/FS. Other points and pathways of exposure are similar to those of on-site workers (see Figure 3-2). Existing groundwater plumes or groundwater potentially impacted by leachate from inactive landfill areas may be released to surface water features (such as the Missouri River) that may be frequented by recreational users. Recreational receptors adjacent to the landfill may come in contact with soil and water contaminated via seeps from the landfill. Gaseous emissions from inactive areas of the landfill would be transported off-site to potential recreational receptor locations. The presumptive remedy eliminates the same exposure points for the recreational receptor as it does for the on-site worker.

On-site Trespassers

On-site trespasser exposure is less likely than on-site worker exposure since trespassers are only occasional visitors to the site, while workers are at the site during normal working days. Therefore, if the risks to workers are acceptable, then the risks to trespassers will also be acceptable. Presently, on-site security and fencing significantly reduce the potential for on-site trespassers.

3.3.5 Potential Ecological Receptors and Exposure Points

Based on the existing site survey and preliminary ecological description (McLaren/Hart, 1994a), no unusual habitats or protected species appear to be present. As described in Section 2.3.8. the site has not yet been surveyed for threatened and endangered species. Inquiry will be made of appropriate state agencies regarding the known occurrence of threatened, endangered, or state-listed species or critical habitat on or near the site. Wetlands are present, and waterfowl may visit the water bodies on the site. Tentatively, wetlands and waterfowl are the preliminary receptors of concern. Other ecological receptors of concern may be identified following site evaluation, and additional pathways may need to be considered at that time. Potential exposure pathways for ecological receptors are depicted in Figure 3-3.

Typically, only ingestion of soil, water, and food items is evaluated for ecological receptors (Opresko, et al., 1994). These exposure routes are generally far more important than the inhalation and dermal exposure routes. Chemicals likely to bioaccumulate significantly were not identified in the second round of sampling by Burns and McDonnell (1986) (see Section 2.3.6.1). The term "bioaccumulate" is used broadly to cover uptake of chemicals by aquatic or terrestrial/avian receptors from water, sediment, soil, or food so that the resulting chemical concentration in the biota tissue is at least one-tenth of the concentration in the original medium. Chemicals that do not bioaccumulate significantly, such as volatile organics, are not likely to be detected in biota tissue unless the chemical concentration in abiotic media (soil, sediment, surface water) is very high. Therefore, sampling biota for non-bioaccumulating chemicals is unlikely to be productive.

Surface water and sediment in wetlands or in ponds will be sampled and analyzed for chemicals of concern where threatened or endangered species (if known or suspected) or waterfowl are likely to be present. If a concern for bioaccumulation arises, a sampling plan will be developed that samples abiotic media using composite or individual samples over the entire exposure or foraging area of the species of concern, and collocates sampling of biota and abiotic media.

Groundwater is not a concern for ecological species until, or unless, it is released to surface water. The potential for such release will be investigated by sampling or modeling along realistic, potential exposure pathways. Direct release from the landfill is unlikely, since the landfill is lined and leachate is actively pumped. Furthermore, the leachate retention pond is synthetically lined and fenced. Release from other unprotected sources will, however, be evaluated for the potential to migrate and release to surface water.

3.3.6 Summary of Potential Exposure Pathways

Figure 3-2 shows a preliminary graphic representation of potential exposure pathways for human receptors. Based on current site understanding, the following appear to be the most important potential human exposure pathways:

- Migration of chemicals from defined sources into the potential leachate in the inactive solid waste landfill;
- Migration of chemicals via discharge of groundwater to surface water or by surface water runoff from OU-2 sources, potentially exposing recreational users (and possibly workers); and,
- Airborne contaminants from sources other than the active solid waste landfill, if these sources exist, potentially exposing residents and recreational users.

Potential ecological receptor exposure pathways of potential significance (shown graphically in Figure 3-3) are:

- Discharge of contaminated groundwater (if identified) to surface water, potentially exposing aquatic and/or avian receptors; and,
- Bioaccumulating chemicals in food items or other ingested or inhaled media potentially exposing all ecological receptors.

3.3.7 Additional Sampling and Screening Recommendations

Initial site characterization will include sampling of sediments, soil, surface water, and groundwater, leachate, and landfill gas. Analytical data from these samples should be adequate for risk assessment purposes, provided that hot spots or known impacted areas are not over-sampled. Chemicals detected during sampling will be screened to determine if they pose a risk to human or ecological receptors. Preliminary screening levels (PSLs) may be developed for chemicals according to the expected exposures. Detection limits for chemicals should be one-half to one-tenth of these screening levels, if possible. It should be noted that EPA guidance for screening levels (EPA, 1991c) is not site-specific; final health-based remedial goals may be higher than the PSLs when site-specific exposure information is used.

The PSLs for chemicals that may cause cancer in humans must assume an acceptable cancer risk level. Current EPA guidance and practice is that CERCLA sites or sub-areas that pose a cancer risk of less than one in 10,000 (10^{-4}) are not likely to need remediation (EPA, 1991c). Therefore, the PSLs established for the West Lake Landfill will use that target risk level.

Chemical concentrations (if detected) may be compared to screening-level benchmarks for avian wildlife such as those found in Opresko, et al., (1994). Since surface water features at and near this site are limited to small ponds and streams, and none are expected to support a fishery, federal Ambient Water Quality Criteria (AWQCs) are not appropriate as screening concentrations.

3.4 Preliminary Identification of Potential Federal and State Applicable or Relevant and Appropriate Regulations

3.4.1 Identification

Section 121(d) of CERCLA requires that remedial actions at NPL sites comply with federal and state applicable or relevant and appropriate requirements (ARARs) under the circumstances presented by the release or threatened release of hazardous substances, pollutants, or contaminants at the site. The ARARs can be grouped into three types:

> *Chemical-specific* ARARs are established health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances. These requirements generally set protective cleanup levels for the chemicals of concern in the designated media, or indicate an acceptable level of chemical discharge to an environmental medium occurring as a result of remedial activity. If a chemical has more than one ARAR, the more stringent requirement is generally complied with. An example of a chemical-specific ARAR is the Safe Drinking Water Act (SDWA) Primary Drinking Water Standard for benzene. The standard was developed to address potential health effects associated with elevated levels of benzene in drinking water supplies.
>
> *Location-specific* ARARs restrict the concentrations of hazardous substances or the type of activities conducted at a site based on the site location. Locations with restrictions include floodplains, wetlands, historic sites, and sensitive ecosystems or habitats. An example of a location-specific ARAR is the National Historical Preservation Act, which requires special consideration whenever a site, building, or object eligible for inclusion in the National Register of Historic Places might be affected by site activities.
>
> *Action-specific* ARARS are those requirements associated with the preliminary response actions under consideration for the site. These ARARs generally set performance, design, or other controls or restrictions on particular kinds of activities related to management of hazardous substances. An example of an action-specific ARAR is found in the RCRA Subtitle D standards applicable to municipal solid waste landfill operators.

A listing of preliminarily-identified chemical-specific federal ARARs is provided in Table 3-1a; state chemical-specific ARARs are listed in Table 3-1b. Tables 3-2a and 3-2b identify federal and state preliminary location-specific ARARs, respectively. Preliminary federal and state action-specific ARARs are identified in Tables 3-3a and 3-3b, respectively.

3.4.2 Point of Compliance

A significant factor for evaluation of remedial alternatives at the West Lake Landfill will be determining the point of applicability for compliance with the ARARs. The point of compliance is the boundary that will be used to assess the effectiveness of the remedial alternatives. The point of compliance will likely be the property boundary. Determining the applicability of ARARs concerning groundwater quality is especially significant for the contaminants and primary exposure pathways identified for the site (See Section 3.3).

For water that is or may be used for drinking, the Maximum Contaminant Levels (MCLs) set under the SDWA are generally the ARARs. The EPA's interim guidance on compliance with ARARs states that "MCLs are applicable at the tap where water will be provided to 25 or more people or will be supplied to 15 or more service connections. Otherwise, where surface water or groundwater is or may be used for drinking, MCLs are generally relevant or appropriate as cleanup standards for the surface water or groundwater" (EPA, 1987a).

The EPA has published guidance on remedial actions for contaminated groundwater at CERCLA sites that is useful in determining cleanup standards and points of applicability (EPA, 1988a). The guidelines discuss EPA's groundwater protection strategy and procedures for classifying groundwater within a prescribed area around a facility or activity based on the value, use, and vulnerability of the groundwater. The groundwater protection strategy establishes three classifications of groundwater, requiring different levels of protection. These classifications are:

Class I: Special groundwater (e.g., sole source aquifers);

Class II (consisting of two subclasses):

Class IIa: Current and potential sources of drinking water, and water having no other beneficial uses; and,

Class IIb: Not currently used as a drinking water source, but a potential source of drinking water, and water having other potential beneficial uses; and, Class III: Groundwater that is not a potential source of drinking water and is of limited potential use due to salinity or widespread contamination.

Drinking water standards are applicable or relevant and appropriate cleanup standards for Class I and Class II groundwater. Drinking water standards are not applicable or relevant and appropriate for Class III groundwater.

3.4.3 ARAR Evaluation

Evaluation of ARARs is an iterative process that will be conducted throughout the RI/FS, such as:

- During the RI, when the public health evaluation is conducted to assess risks, the chemical-specific and location-specific ARARs will be identified in detail and will be used to help determine remedial action goals;
- During the development of remedial alternatives in the FS, action-specific ARARs will be identified for each of the proposed alternatives and will be considered along with other ARARs; and,
- During detailed analysis of alternatives in the FS, all ARARs for each alternative will be examined as a package to determine what is needed to comply with other laws and be protective of public health and the environment.

Following completion of the RI/FS, the remedial alternative selected must be able to attain all ARARs unless one of the six statutory waivers provided in Section 121(d)(4)(A) through (F) of CERCLA is invoked. This will be documented in the Record of Decision (ROD). Finally, during remedial design, the technical specifications of construction must ensure attainment of ARARs.

The six potential ARARs waivers are:

- The remedial action is an interim measure where the final remedy will attain ARARs upon completion;

- Compliance will result in greater risk to human health and the environment than other options;

- Compliance is technically impractical from an engineering standpoint;

- An alternative remedial action will attain the equivalent performance as the ARAR;

- For state ARARs, the state has not consistently applied (or demonstrated the intention to consistently apply) the requirements in similar circumstances; and,

- For CERCLA-financed actions under Section 104, compliance with the ARAR will not provide a balance between the need for protecting public health, welfare, and the environment at the facility, and the need for fund money to respond to other sites.

3.5 Preliminary Identification of Remedial Action Objectives

A preliminary identification of remedial action objectives has been conducted, based on the preliminary risk assessment and EPA guidance in *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA, 1991e) and *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA, 1993a). The remedial action objectives may be used to identify potential remedial technologies and actions, which will help to develop preliminary remedial alternatives. The overall objective of the remedial action is to maintain the risk to human health and the environment at an acceptable level.

In accordance with the requirements of the AOC and SOW (EPA, 1994b), the presumptive remedy model has been used to develop remedial action objectives for the site. This model assumes that remedial action for municipal landfill sites is best accomplished by containment technologies, because the volume and heterogeneity of the waste generally make treatment impractical (EPA, 1993a). The presumptive remedy remedial action objectives are:

- Preventing direct contact with landfill contents;

- Minimizing infiltration and resulting contaminant leaching to groundwater;

- Controlling surface water runoff and erosion;
- Collecting and treating contaminated groundwater and leachate to contain the contaminant plume and prevent further migration from the contaminant source; and,
- Controlling and treating landfill gas.

Each of these objectives are addressed by containment technologies. According to the EPA (1993a), additional remedial action objectives not addressed by the presumptive remedy are:

- Remediating groundwater;
- Remediating contaminated surface water and sediments; and,
- Remediating contaminated wetland areas.

All response objectives are addressed in this Work Plan in the following sections; however, the RI/FS will focus on the three response objectives not addressed by the presumptive remedy.

3.6 Preliminary Identification of Remedial Action Alternatives

According to EPA guidance, "use of the presumptive remedy eliminates the need for initial identification and screening of alternatives during the feasibility study." As described in Section 3.3, the presumptive remedy model recommends use of containment as the remedial action appropriate for CERCLA municipal landfill sites, and has been included as part of the Statement of Work for this site (EPA, 1994b).

Although the presumptive remedy has identified the response actions for the containment approach, remedial action alternatives will be assembled for each component or combinations of components for detailed evaluation in the Feasibility Study. For example there may be several different applicable types of landfill capping alternatives that may be considered for further evaluation during the FS.

"Hot Spot" areas, for which other remedial actions may be feasible, potentially are present at the site. Remedial action alternatives other than containment will be identified and evaluated if hot spots are discovered during the site investigation. Remedial action alternatives appropriate for hot spots may include soil excavation and disposal, or thermal or physical solids treatment.

3.6.1 Presumptive Remedy

Remedial action alternatives considered for the West Lake site are based on EPA guidance provided in *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA, 1991e), as modified by recommendations in *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA, 1993a). As previously stated, the presumptive remedy for municipal landfills is containment. Containment consists of:

- Landfill capping;
- Source area groundwater control to contain contaminant plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment; and/or,
- Institutional controls to supplement engineering controls.

The following discussion describes remedial action objectives addressed by these response actions.

Prevent Direct Contact

Containment prevents direct contact with landfill contents and contaminated soils by placing a cap of materials such as low permeability soils over the landfill, and controlling access with fences, a manned entrance station during operating hours, and signage. The West Lake Landfill currently prevents direct contact by incorporating these measures.

Minimize Infiltration

Infiltration of stormwater runoff is minimized by the landfill cap, constructed with low permeability soils to promote runoff rather than infiltration. Current site drainage is intended to minimize infiltration.

Control Surface Water and Erosion

Surface water and erosion is controlled with appropriate grading to direct drainage away from potential contamination sources. A Stormwater Management Plan (SMP) is used to verify and document that engineering controls are in place and are effective.

Collect and Treat Groundwater and Leachate

Leachate has been collected and treated at the site since 1979. The leachate collection system was designed to maintain an inward gradient flow of groundwater towards the active landfill, minimizing the potential for contaminated groundwater to migrate from the site. Treatment of collected leachate and groundwater consists of aeration in a treatment pond located on the southern extreme of the property. If necessary, the existing leachate collection system could be expanded to include the inactive landfill area.

Control and Treat Landfill Gas

Landfill gases have been collected and thermally treated at the active landfill since 1982. If necessary, the landfill gas collection system may be expanded to include inactive landfill areas.

3.6.2 <u>Non-Presumptive Remedy</u>

The following section described remedial action objectives for impacted media not included in the presumptive remedy.

Remediate Contaminated Groundwater

This Work Plan identifies methods to be used to fully characterize groundwater beneath the site, including any contamination originating from current or past site activities. When the groundwater quality is fully characterized, remedial action alternatives to restore groundwater quality will be identified, if necessary.

Remediate Contaminated Surface Water and Sediments

This Work Plan similarly identifies methods to characterize surface water and sediments at the site, including any contamination originating from current or past site activities. Remedial action alternatives for surface water and sediment contamination, if necessary, will be identified following characterization of these media.

Remediate Contaminated Wetlands

No natural wetlands areas are currently present at the site. This Work Plan includes methods to identify and characterize natural wetlands; remedial action alternatives to address any identified contamination will be developed, if necessary.

3.6.3 No Action Alternative

Under the no action alternative, remedial actions would not be undertaken under CERCLA, and the site would remain in its current position of being under the direction and control of the State of Missouri solid waste regulations and the Federal RCRA Subtitle D regulations. The no action alternative provides a baseline against which the other alternative(s) can be compared.

TABLE 3-1a

POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

<table>
<tr><th>Chemical</th><th>Medium</th><th>Requirement</th><th>Citation</th><th>Comments</th></tr>
<tr>
<td>See Table</td>
<td>Water</td>
<td>Maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs) for drinking water supplies are as follows:
<table>
<tr><th>Contaminant</th><th>Unit</th><th>MCL</th><th>SMCL</th></tr>
<tr><td><u>Metals:</u></td><td></td><td></td><td></td></tr>
<tr><td>Antimony</td><td>ug/L</td><td>6</td><td>--</td></tr>
<tr><td>Arsenic</td><td>ug/L</td><td>50</td><td>--</td></tr>
<tr><td>Beryllium</td><td>ug/L</td><td>4</td><td>--</td></tr>
<tr><td>Cadmium</td><td>ug/L</td><td>5</td><td>--</td></tr>
<tr><td>Cobalt</td><td>ug/L</td><td>5</td><td>--</td></tr>
<tr><td>Copper</td><td>ug/L</td><td>--</td><td>1,000</td></tr>
<tr><td>Cyanide</td><td>ug/L</td><td>200</td><td></td></tr>
<tr><td>Lead</td><td>ug/L</td><td>15</td><td>--</td></tr>
<tr><td>Molybdenum</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Nickel</td><td>ug/L</td><td>100</td><td>--</td></tr>
<tr><td>Selenium</td><td>ug/L</td><td>50</td><td></td></tr>
<tr><td>Thallium</td><td>ug/L</td><td>2</td><td>--</td></tr>
<tr><td><u>Anions:</u></td><td></td><td></td><td></td></tr>
<tr><td>Nitrates (as N)</td><td>mg/L</td><td>10</td><td>--</td></tr>
<tr><td><u>Radionuclides:</u></td><td></td><td></td><td></td></tr>
<tr><td>Gross alpha*</td><td>pCi/L</td><td>15</td><td>--</td></tr>
<tr><td>Radium-226 and Radium-228</td><td>pCi/L</td><td>5</td><td>--</td></tr>
<tr><td><u>Organics:</u></td><td></td><td></td><td></td></tr>
<tr><td>Chlordane</td><td>mg/L</td><td>0.002</td><td></td></tr>
<tr><td>Lindane</td><td>mg/L</td><td>0.0002</td><td></td></tr>
<tr><td>Endrin</td><td>mg/L</td><td>0.002</td><td></td></tr>
<tr><td>Hexachlorobenzene</td><td>mg/L</td><td>0.001</td><td></td></tr>
</table>
* Including Radium-226 but excluding radon and uranium.</td>
<td>Safe Drinking Water Act (42 USC 300 G), 40 CFR Part 141, Subpart B), 40 CFR Part 143.3</td>
<td>Because the site is not a public water system, these regulations are not applicable. Groundwater at the site is not currently utilized as drinking water sources; however, such groundwaters could be classified by the EPA as potentially potable. Surface waters near the site i.e., Missouri and Mississippi Rivers, may be potential drinking water sources, and these standards may be relevant and appropriate.</td>
</tr>
</table>

TABLE 3-1a

POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Chemical	Medium	Requirement	Citation	Comments
See Table	Water	Proposed maximum contaminant levels (PMCLs) and proposed secondary maximum contaminant levels (PSMCLSs) for drinking water supplies is as follows: Contaminant / Unit / MCL / SMCL __Metals:__ Antimony / ug/L / -- / -- Arsenic / ug/L / 50 / -- Beryllium / ug/L / -- / -- Cadmium / ug/L / 10 / -- Cobalt / ug/L / -- / -- Copper / ug/L / -- / 1,000 Lead / ug/L / 50 / -- Molybdenum / ug/L / -- / -- Nickel / ug/L / -- / -- Selenium / ug/L Thallium / ug/L / -- / -- __Anions:__ Nitrates (as N) / mg/L / 10 / --	National Primary and Secondary Drinking Water Regulations (54 FR 97, May 22, 1989), Proposed Rules); Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper (53 FR 160, August 18, 1988, Proposed Rules).	Because the site is not a public water system, these regulations are not applicable. Groundwater at the site is not currently utilized as drinking water sources; however, such groundwaters could be classified by the EPA as potentially potable.
Any	Water	States are responsible for reviewing, establishing, and revising water quality standards in accordance with EPA guidance and approval. Permitting authority for surface water discharges is delegated to the states according to the National Pollutant Discharge Elimination Systems (NPDES) process.	Federal Water Pollution Control Act, Clean Water Act (33 USC 1251-1376, 40 CFR Part 131, 40 CFR Parts 122-125	State water quality standards would be applicable to any surface-water discharges.

TABLE 3-1b

POTENTIAL STATE CHEMICAL-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

<table>
<tr><th>Chemical</th><th>Medium</th><th>Requirement</th><th>Citation</th><th>Comments</th></tr>
<tr>
<td>See Table</td>
<td>Water</td>
<td>Maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs) for drinking water supplies are as follows:
<table>
<tr><th>Contaminant</th><th>Unit</th><th>MCL</th><th>SMCL</th></tr>
<tr><td><u>Metals:</u></td><td></td><td></td><td></td></tr>
<tr><td>Antimony</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Arsenic</td><td>ug/L</td><td>50</td><td>--</td></tr>
<tr><td>Beryllium</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Cadmium</td><td>ug/L</td><td>5</td><td>--</td></tr>
<tr><td>Cobalt</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Copper</td><td>ug/L</td><td>--</td><td>1,000</td></tr>
<tr><td>Lead</td><td>ug/L</td><td>15</td><td>--</td></tr>
<tr><td>Molybdenum</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Nickel</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td>Selenium</td><td>ug/L</td><td>50</td><td></td></tr>
<tr><td>Thallium</td><td>ug/L</td><td>--</td><td>--</td></tr>
<tr><td><u>Anions:</u></td><td></td><td></td><td></td></tr>
<tr><td>Nitrates (as N)</td><td>mg/L</td><td>10</td><td>--</td></tr>
<tr><td><u>Radionuclides:</u></td><td></td><td></td><td></td></tr>
<tr><td>Gross alpha*</td><td>pCi/L</td><td>15</td><td>--</td></tr>
<tr><td>Radium-226 and Radium-228</td><td>pCi/L</td><td>5</td><td>--</td></tr>
<tr><td><u>Chlorinated Hydrocarbons:</u></td><td></td><td></td><td></td></tr>
<tr><td>Endrin</td><td>μg/L</td><td>2</td><td>--</td></tr>
<tr><td>Lindane</td><td>μg/L</td><td>3</td><td>--</td></tr>
<tr><td><u>Volatile Organic Chemicals:</u></td><td></td><td></td><td></td></tr>
<tr><td>Benzene</td><td>mg/L</td><td>0.005</td><td></td></tr>
<tr><td>Carbon Tetrachloride</td><td>mg/L</td><td>0.005</td><td></td></tr>
<tr><td>para-Dichlorobenzene</td><td>mg/L</td><td>0.075</td><td></td></tr>
<tr><td>1,4-Dichlorobenzene</td><td>mg/L</td><td>0.400</td><td></td></tr>
<tr><td>1,1-Dichloroethylene</td><td>mg/L</td><td>0.007</td><td></td></tr>
<tr><td>1,1,1-Trichlorethane</td><td>mg/L</td><td>0.20</td><td></td></tr>
<tr><td>Trichloroethane</td><td>mg/L</td><td>0.005</td><td></td></tr>
<tr><td>Vinyl chloride</td><td>mg/L</td><td>0.002</td><td></td></tr>
</table>
* Including Radium-226 but excluding radon and uranium.</td>
<td>Missouri Safe Drinking Water Act and Missouri Public Drinking Water Regulations</td>
<td>Because the site is not a public water system, these regulations are not applicable. Groundwater at the site is not currently utilized as drinking water sources; however, such groundwaters could be classified by the EPA as potentially potable.</td>
</tr>
</table>

TABLE 3-1b

POTENTIAL STATE CHEMICAL-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Chemical	Medium	Requirement	Citation	Comments
Those listed in specific criteria of state water quality standards	Water	When water quality exceeds levels necessary to protect beneficial uses, that quality shall be fully maintained and protected. Lowered water quality is allowable only under certain conditions and full satisfaction of intergovernmental and public participation provisions.	Missouri Water Quality Standards, Antidegradation (10 CSR 7.031 (2))	Any surface water discharges are not anticipated to lower the water quality of the Missouri and Mississippi rivers.
General	Water	No contaminant, by itself or in combination with other substances, shall prevent the waters of the state from being (a) free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses; (b) free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses; (c) free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses; and (d) free from substances or conditions in sufficient amounts to have a harmful effect on human, animal, or aquatic life.	Missouri Water Quality Standards, General Criteria (10 CSR 20-7.031 (3))	Any surface water discharges are not anticipated to cause such effects in the water which they would be discharged.
Table A of cited regulation	Water	Water contaminants should not exceed the criteria for designated uses (Table A of the cited regulation).	Missouri Water Quality Standards, Specific Criteria (10 CSR 20-7.031 (4))	These requirements are based on the most restrictive contaminant concentrations allowable for the designated uses of tributaries to the Missouri and Mississippi rivers; therefore, these requirements may be applicable to the remedial action.
See Table	Water		Missouri Water Quality Standards, Specific Criteria (10 CSR 20-7.031 (4))	These requirements are based on the most restrictive contaminant concentrations allowable for the designated uses of tributaries to the Missouri and Mississippi rivers; therefore, these requirements may be applicable to the remedial action.
	Water	Other potentially toxic substances for which sufficient toxicity data are not available may not be released to waters of the state until safe levels are demonstrated through bioassay studies.	Missouri Water Quality Standards, Toxic Substances (10 CSR 20-7.031 (4) (B))	No such substances are anticipated from leachate or run-off from site soils.

TABLE 3-1b

POTENTIAL STATE CHEMICAL-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Chemical	Medium	Requirement	Citation	Comments
Radionuclides	Water	All streams and lakes shall conform with state and federal limits for radionuclides established for drinking water supply.	Missouri Water Quality Standards, Radioactive Materials (10 CSR 7.031 (4) (F))	This requirement may be applicable to remedial action activities.
Particulate Matter	Air	No person may permit the handling, transport, or storage of any material in a way that allows unnecessary amounts of fugitive particulate matter to become airborne and that results in at least one complaint being filed. To prevent particulate matter from becoming airborne during construction, use, repair, or demolition of a road, driveway, or open area, the following measures may be required: paving or frequent cleaning of roads, applying dust-free surfaces or water, and planting and maintaining a vegetative ground cover. (Unpaved public roads in unincorporated areas that are in compliance with particulate matter standards are excluded.)	Missouri Air Pollution Control Regulations; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.100), Preventing Particulate Matter from Becoming Airborne	The requirements may be relevant and appropriate to the control of particulate emissions that could result during implementation of the remedial action.
Particulate Matter	Air	Visible air contaminants (other than uncombined water) may not be released from an internal combustion engine for more than 10 seconds at any one time.	Missouri Air Pollution Control Regulation; Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area (10 CSR 10-5.180), Emission of Visible Air Contaminants from Internal Combustion Engines	These requirements may be applicable to particulates released from any internal combustion engines used during implementation of the remedial action.

TABLE 3-2a

POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Location	Requirement	Prerequisite(s)	Citation	Comments
Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values of the floodplain.	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	Executive Order 11988, 40 CFR Part 6, Appendix A	Applicable if part of the site is in the 100-year floodplain. (Site is not within floodplain due to constructed levees along river.)
Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior	Determination of endangered species or threatened species.	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 2000, 50 CFR Part 402; 40 CFR 6.302(h)	Need to identify whether any endangered species are known to exist on the Site.
Wetland	Action to minimize the destruction, loss, or degradation of wetlands. Action to prohibit discharge of dredge or fill material into wetland without permit.	Wetland as defined by Executive Order 11990 Section 7.	Executive Order 11990, 40 CFR Part 6, Appendix A Clean Water Act Section 404; 40 CFR Parts 230, 231	Applicable if wetlands are present next to or on the site.
Wilderness area	Area must be administered in such a manner as will leave it unimpaired as wilderness and to preserve its wilderness character.	Federally owned area designated as wilderness area.	Wilderness Act (16 USC 1131 et seq.);50 CFR 35.1 et seq.	Not applicable if the Site is not within a Federal Wilderness Area.
Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd(c) may be undertaken in areas that are part of the National Wildlife Refuge System.	Area designated as part of National Wildlife Refuge System.	16 USC 668 dd et seq.; 50 CFR Part 27	Not applicable if the Site is not within a National Wildlife Refuge.

TABLE 3-2a

POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Location	Requirement	Prerequisite(s)	Citation	Comments
Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river.	Activities that affect or may affect any of the rivers specified in Section 1276(a).	Scenic Rivers Act (16 USC 1271 et seq. Section 7(a); 40 CFR 6.302(e)	Not applicable if national wild or scenic rivers are not located on the site and will not be affected by site remediation.
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts.	Action to recover and preserve artifacts.	Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data.	National Archaeological and Historical Preservation Act (16 USC Section 469); 40 CFR 6.301(c); PL 93-291; 88 stat. 174; 36 CFR Part 65	Should scientific, prehistorical, or historical artifacts be found at the site, this will become applicable.
Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks.	Property included in or eligible for the National Register of Historic Places.	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 40 CFR 6.301(b); 36 CFR Part 800	Applicable if the site is included in the National Register of Historic Places.
Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks.	Property included in or eligible for the National Register of Historic Places.	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 36 CFR Part 800	Applicable if the site is included in the National Register of Historic Places.
Land	Cultural resources, such as historic buildings and sites and natural landmarks, must be preserved on federal land to avoid adverse impacts.		Antiquity Act; Historic Sites Act (16 USC 431-433. 16 USC 461-467; 40 CFR 6.301(a))	No adverse impacts to such resources are expected to result from remedial action at the site; however, if these resources were affected, the requirement would be applicable.

TABLE 3-2a

POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Location	Requirement	Prerequisite(s)	Citation	Comments
Land	A permit must be obtained if an action on public or Indian lands could Impact archeological resources.		Archeological Resources Protection Act (16 USC 470(a))	No impacts to archeological resources are expected to result from remedial action activities. The site is located in an area that has been considerably disturbed by past human activities; therefore, this area is not expected to contain any such resources. However, if these resources were affected, the requirement would be applicable.
Land	Historic, architectural, archeological, and cultural resources must be preserved, restored, and maintained, and must be evaluated for inclusion in the National Register.		Protection and Enhancement of the Cultural Environment (Executive Order 11593; 40 CFR Part 6.301)	No impacts to such resources are expected to result from remedial action activities. The site is located in an area that has been considerably disturbed by past human activities; therefore, this area is not expected to contain any such resources. However, if these resources were affected, the requirement would be applicable.
Area affecting stream or river	Action to protect fish or wildlife.	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR Part 6.302	The Fish and Wildlife Coordination Act requires consultation with the Department of Fish and Wildlife prior to any action that would alter a body of water of the United States.

TABLE 3-2b

POTENTIAL STATE LOCATION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Location	Requirement	Prerequisite(s)	Citation	Comments
Any	Endangered species, i.e., those designated by the Missouri Department of Conservation and the U.S. Department of the Interior as threatened or endangered (see 1978 Code, RSMO. 252.240) may not be pursued, taken, possessed, or killed.		Missouri Wildlife Code (1989) RSMo. 252.240; 3 CSR 10-4.111), Endangered Species	No critical habitat is known to exist in the affected area, and no adverse impacts to threatened or endangered species are expected to result from remedial action activities. However, if such species were affected the requirement would be applicable.
Any	Wildlife, including their homes and eggs, may not be taken or molested.		Missouri Wildlife Code (1989)(RSMo. 252.240; 3 CSR 10-4.110) General Prohibition; Applications	No wildlife would be actively taken or molested as part of the remedial action. However, wildlife could be disturbed during implementation. Mitigative measures would be taken to minimize potential adverse impacts.
Any	Wildlife may not be taken, pursued, or molested on any state or federal wildlife refuge or any wildlife management area, except under permitted conditions.		Missouri Wildlife Code (1989) (RSMo. 252.240; 3 CSR 10-4.115), Special Management Areas	Not applicable because the site is not a wildlife refuge or management area. No wildlife would be actively taken, pursued, or molested in any wildlife area as part of remedial action activities. However, wildlife could be disturbed during implementation. Mitigative measures would be taken to minimize potential adverse impacts.
Any	Wildlife may not be taken or pursued, except under permitted conditions.		Missouri Wildlife Code (1978)(RSMo. 252.240), Taking of Wildlife - Rules and Regulations	No wildlife would be actively taken or pursued as part of remedial action activities. However, wildlife could be disturbed during implementation. Mitigative measures would be taken to minimize potential adverse impacts.
Any	The Missouri Department of Conservation must file with the state a list of animal species designated as endangered (for subsequent consideration of related requirements).		Missouri Wildlife Code (1978)(RSMo. 252.240), Endangered species importation, transportation or sale, when prohibited - how designated - penalty	No critical habitat is known to exist in the affected area, and no adverse impacts to threatened or endangered species are expected to result from remedial action activities. However, if such species were affected, the requirement would be applicable.

TABLE 3-2b

POTENTIAL STATE LOCATION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Location	Requirement	Prerequisite(s)	Citation	Comments
Stream	It is unlawful to put any deleterious substances into waters of the state in quantities sufficient to injure fish, except under precautionary measures approved by the commission.		Missouri Wildlife Code (1978)(RSMo. 252.210), Contamination of streams	It is not anticipated that quantities of deleterious substances sufficient to injure fish would be discharged to any waters of the state.
Floodplain	Potential effects of actions taken in a floodplain must be evaluated to avoid adverse impacts.		Governors Executive Order 82-19	Parts of the site are in a historic floodplain; the provisions of this regulation might applicable. However, the site is currently protected from flooding by levees.
Land	Landfill location standards.		Missouri Hazardous Waste Management Regulations (1987) 10 CSR 25	Siting standards for hazardous waste disposal facilities in Missouri may need to be considered when evaluating remedial action alternatives for the Site.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Capping	A Municipal Solid Waste Landfill (MSWLF) unit must have a cap that is designed to minimize infiltration and erosion. The final cover system must be designed and constructed to: 1) have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present, or a permeability no greater than 1 x 10^{-5} cm/s, 2) minimize infiltration by the use of a layer of 18 inches of earthen material, and 3) minimize erosion by the use of an erosion layer that contains at least 6 inches of earthen material capable of sustaining vegetative growth.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.60	The substantive requirements of Resource Conservation and Recovery Act (RCRA) Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF Comprehensive Environmental Resonse, Compensation, and Liability Act (CERCLA) response actions that occur after October 9, 1993.
Gas Control	The concentration of methane must not exceed 25% of the lower explosive limit (LEL) for methane in any facility structures (excluding gas control systems). A MSWLF unit must not exceed 100% LEL for methane at the property boundary. A landfill gas monitoring plan must be developed for the MSWLF unit.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.23	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Post Closure Care	Following closure of each MSWLF unit, the owner or operator must conduct post-closure care. Post-closure care must be conducted for 30 years. The care must include: groundwater monitoring, gas monitoring, gas control, cap maintenance, etc.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.61	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Deed Restrictions	A notation must be placed on the deed in perpetuity notifying any potential purchaser that the property: 1) has been used as landfill, and 2) its use is restricted under 40 CFR Part 258.61(c)(3).	Municipal Solid Waste Landfill Unit	40 CFR Part 258.60(i)	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Surface Water Control	A MSWLF unit shall not: a) cause a discharge of pollutants to the waters of the United States, including wetlands, that violates any requirement of the Clean Water Act (CWA), including but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402; b) cause the discharge of a nonpoint source of pollution to waters of the United States, including wetlands, that violates any requirements of a State-wide water quality management plan that has been approved under Section 208 or 319 of the CWA.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.27	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Groundwater Monitoring System	A groundwater monitoring system must be installed that consists of a sufficient number of wells, installed at appropriate location and depths, to yield groundwater samples from the upper most aquifer (as defined in 40 CFR Part 258.2).	Municipal Solid Waste Landfill Unit	40 CFR Part 258.51	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Groundwater Sampling and Analysis	The groundwater monitoring program must include consistent sampling and analysis procedures designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells installed in compliance with 40 CFR Part 258.51(a).	Municipal Solid Waste Landfill Unit	40 CFR Part 258.53	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Groundwater Monitoring	MSWLF units are required to have a Detection Monitoring Program that includes at a minimum all of the constants listed in RCRA Subtitle D Appendix I. Assessment Monitoring is required if a statistically significant increase over background has been detected for any of the Appendix I parameters. The Assessment Monitoring Program will include at a minimal, all of the constituents listed on RCRA Subtitle D Appendix II.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.54-.55	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements of MSWLF CERCLA response actions that occur after October 9, 1993.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Financial Assurance	The owner or operator must maintain continuous coverage for post-closure care until released from financial assurance requirements for post-closure care by demonstrating compliance with 40 CFR Part 258.61.	Municipal Solid Waste Landfill Unit	40 CFR Part 258.72	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Air Criteria	Owners or operators must ensure that the units do not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the EPA Administrator pursuant to Section 100 of the Clean Air Act (CAA).	Municipal Solid Waste Landfill Unit	40 CFR Part 258.24	The substantive requirements of RCRA Subtitle D regulations will be considered relevant and appropriate requirements for MSWLF CERCLA response actions that occur after October 9, 1993.
Direct Discharge of Treatment System Effluent	Applicable federal water quality criteria for the protection of aquatic life must be complied with when environmental factors are being considered.	Surface discharge of treated effluent.	50 CFR 30784 (July 29, 1985)	
	Applicable federal approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Surface discharge of treated effluent.	40 CFR Part 122.44 and state regulations approved under 40 CFR Part 131	If state regulations are more stringent than federal water quality standards, the state standards will be applicable to direct discharge. The state has authority under 40 CFR Part 131 to implement direct discharge requirements within the state, and should be contacted on a case-by-case basis when direct discharges are contemplated.
	The discharge must be consistent with the requirements of a Water Quality Management plan approved by EPA under Section 208(b) of the CWA.		CWA Section 208(b)	Discharge must comply with substantive but not administrative requirements of the management plan.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (continued)	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology based limitations may be determined on a case-by-case basis.	Surface discharge of treated effluent.	40 CFR Part 122.44(a)	If treated effluent is discharged to surface waters, these treatment requirements will be applicable. Permitting and reporting requirements will be applicable only if the effluent is discharged at an off-site location. The permitting authority should be contacted on a case-by-case basis to determine effluent standards.
	Discharge limitations must be established for all toxic pollutants that are or may be discharge at levels greater than those that can be achieved by technology-based standards.	Surface discharge of treated effluent.	40 CFR Part 122.44(e)	Exact limitations are based on review of the proposed treatment system and receiving water characteristics, and are usually determined on a case-by-case basis. The permitting authority should be contacted to determine effluent limitations.
	Discharger must be monitored to assure compliance. Discharge will monitor: ▸ The mass of each pollutant discharged. ▸ The volume of effluent discharged. ▸ Frequency of discharge and other measurements as appropriate.	Surface discharge of treated effluent.	40 CFR Part 122.44(i)	These requirements are generally incorporated into permits, which are not required for on-site discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that the discharge standards are being met. The permitting authority should be contacted to determine monitoring and operational requirements.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (continued)	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided. Permit application information must be submitted, including a description of activities, listing of environmental permits, etc. Monitor and report results as required by permit (at least annually).		 40 CFR Part 122.21 40 CFR Part 122.44(i)	
	Comply with additional permit conditions such as: ▸ Duty to mitigate any adverse effects of any discharge. ▸ Proper operation and maintenance of treatment systems.		40 CFR Part 122.41(i)	

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR
WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (continued)	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters. The BMP program must: ► Establish specific procedures for the control of toxic and hazardous pollutant spills. ► Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure. ► Assure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA.	Surface water discharge.	40 CFR Part 125.100	The issues are determined on a case-by-case basis by the NPDES permitting authority for any proposed surface discharge of treatment wastewater. Although a CERCLA site remediation is not required to obtain an NPDES permit for on-site discharges to surface waters, the substantive requirements of the NPDES permit program must be met by the remediation action if possible. The permitting authority should be consulted on a case-by-case basis to determine BMP requirements.
	Sample preservation procedures container materials, and maximum allowable holding items are prescribed.	Surface water discharge.	40 CFR Part 136.1-136.4	These requirements are generally incorporated into permits, which are not required for on-site discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that standards are being met. The permitting authority should be consulted on a case-by-case basis to determine analytical requirements.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Discharge to POTW	Pollutants that pass through the Publicly-Owned Treatment Works (POTW) without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited.		40 CFR Part 403.5	If any liquid is discharged to a POTW, these requirements are applicable. In accordance with guidance, a discharge permit will be required even for an on-site discharge, since permitting is the only substantive control mechanism available to a POTW.
	Specific prohibitions preclude the discharge of pollutants to POTWs that: ► Create a fire or explosion hazard in the POTW. ► Are corrosive (pH <5.0) ► Obstruct flow resulting in interference. ► Increase the temperature of wastewater entering the treatment plant that would result in interference, but in no case raise the POTW influent temperature above 104°F (40°C). Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements. RCRA permit-by-rule requirements must be complied with for discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe.		40 CFR Part 403.5 and local POTW regulations 40 CFR Part 264.71 40 CFR Part 264.72	Categorical standards have not been promulgated for CERCLA sites, so discharge standards must be determined on a case-by-case basis, depending on the characteristics of the waste steam and the receiving POTW. Some municipalities have published standards for non-categorical, non-domestic discharges. Changes in the composition of the waste stream due to pretreatment process changes or the addition of new waste streams will require renegotiation of the permit conditions.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Dredging	Removal of all contaminated sediment.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See discussions under Clean Closure, Consolidation, and Capping.	
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	40 CFR Part 264	If contaminated materials that are not hazardous wastes are excavated from the site during remediation, the RCRA requirements for disposal and site closure (of the excavated area) will be considered in light of the Corrective Action Management Unit (CAMU) rulemaking. See discussions under Capping, Clean Closure, Closure with Waste In Place, etc.
	All listed and characteristic hazardous wastes or soils and debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by the Land Disposal Restrictions. If alternative treatment technologies can achieve treatment similar to that required by the Land Disposal Restrictions, and if this achievement can be documented, than a variance may not be required.	Waste disposed was RCRA waste.	40 CFR Part 268	If soil is a characteristic waste, and if waste disposed prior to November 1980 is now designated as an RCRA waste, then soils/sediment and leachate contamination from those wastes must be managed as an RCRA waste.
	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.		CAA Section 101 and 40 CFR 52	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.		40 CFR Part 52	See discussions under Consolidation.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Excavation (continued)	Include with the files APEN the following: ▸ Modeled impact analysis of source emissions. ▸ A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR Part 52	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR Part 61	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR Part 61	See discussions under Consolidation.
Gas Collection	Design system to provide odor-free operation.		CAA Section 101 and 40 CFR Part 52	See discussions under Consolidation.
	File an APEN with state to include estimation of emission rates for each pollutant expected.		40 CFR Part 52	See discussions under Consolidation.
	Include with the filed APEN the following: ▸ Modeled impact analysis of source emissions. ▸ A Best Available control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR Part 52	See discussions under Consolidation.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Gas Collection (continued)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR Part 52	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.01 ppm.		40 CFR Part 61	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR Part 61	See discussions under Consolidation.
Land Treatment	Ensure that hazardous constituents are degraded, transformed, or immobilized within the treatment zone.	RCRA hazardous waste.	40 CFR Part 264.271	See discussions under Consolidation.
	Maximum depth of treatment zone must be no more than 1.5 meters (5 feet) from the initial soil surface, and more than 1 meter (3 feet) above the seasonal high water table.		40 CFR Part 264.271	
	Demonstrate that hazardous constituents for each waste can be completely degraded, transformed, or immobilized in the treatment zone.		40 CFR Part 264.272	
	Minimize run-off of hazardous constituents.		40 CFR Part 264.273	

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Land Treatment (continued)	Maintain run-on/run-off control and management system.		40 CFR Part 264.273	
	Special application conditions if food-chain crops are grown in or on treatment zone.		40 CFR Part 264.276	
	Unsaturated zone monitoring.		40 CFR Part 264.278	
Removal	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products.	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination.	40 CFR Part 264.111	Clean closure removal of contaminate materials does not appear to be feasible for municipal landfill sites in general due to the lack of suitable off-site treatment or disposal facilities to accept the large volume of wastes typically found at municipal landfill sites and the impossibility of meeting the requirement at a site with portions (hot spots) of municipal landfill sites. The presumptive remedy (containment) is therefore recommended.
	Disposal or decontamination of equipment, structures, and soils.	May apply to surface impoundment or to contaminated soil, including soil from dredging or soil disturbed in the course of drilling or excavation and returned to land.	40 CFR Part 264.111	

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Removal (continued)	Removal or decontamination of all waste residues, contaminated containment system components (e.g., liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste. The effective date for final group of RCRA wastes is May 8, 1990. Extensions to the effective dates have been granted for specific RCRA wastes that are contained in soil and/or debris.	Not applicable to undisturbed material. Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR Part 264.228(a)(I) and 40 CFR Part 264.258	
	Meet health-based levels at unit.		40 CFR Part 244.11	
	RCRA hazardous wastes are subject to land disposal restrictions. Land disposal restrictions set performance requirements on treatment of the wastes before land disposal. The effective date for final group of RCRA wastes is May 8, 1990. Extensions to the effective dates have been granted for specific RCRA wastes that are contained in soil and/or debris.	Management of listed hazardous waste.	40 CFR Part 268	Such management will be considered in light of the CAMU rulemaking.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Treatment	Standards for miscellaneous units (long-term retrievable storage, thermal treatment other than incinerators, open burning, open detonation, chemical, physical, and biological treatment units using other than tanks, surface impoundments, or land treatment units) require new miscellaneous units to satisfy environmental performance standards by protection of groundwater, surface water, and air quality, and by limiting surface and subsurface migration.	Use of other units for treatment of hazardous wastes. These units do not meet the definitions for units regulated elsewhere under RCRA.	40 CFR Part 264 Subpart X	The requirement will be relevant and appropriate to the construction, operation, maintenance, and closure of any miscellaneous treatment unit (a treatment unit that is not elsewhere regulated) constructed on municipal landfill site for treatment and/or disposal of hazardous wastes. These requirements would be applicable to the construction and operation of a miscellaneous treatment unit for the treatment and/or disposal of hazardous waste.
	Treatment of wastes subject to ban on land disposal must attain levels achievable by Best Demonstrated Available Treatment Technologies (BDAT) for each hazardous constituent in each listed waste.	Effective date for CERCLA actions is November 8, 1988, for F001-F005 hazardous wastes, dioxin wastes, and certain "California List" wastes. Other restricted wastes have different effective dates as promulgated in 40 CFR 268.	40 CFR Part 268 Subpart D	Such management will be considered in light of the CAMU rulemaking.
	Prepare fugitive and odor emission control plan for this action.		CAA Section 10 and 40 CFR Part 52	See discussions under Consolidation.
	File an APEN with state to include estimation of emission rates for each pollutant expected.		40 CFR Part 52	See discussions under Consolidation.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Treatment (continued)	Include with the filed APEN the following: ▸ Modeled impact analysis of source emissions. ▸ A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment area.	40 CFR Part 52	See discussions under Consolidation.
	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR Part 52	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.01 ppm.		40 CFR Part 61	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR Part 61	See discussions under Consolidation.
Demolition	The public must be protected from noises (e.g., that could result from demolition activities) that jeopardize health or welfare.		40 CFR Part 61	

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

Actions	Requirement	Prerequisites	Citation	Comments
Waste Treatment Storage, or Disposal	General requirements are established for facility location and inspection, waste compatibility determination, and worker training. Location requirements include (1) facilities must not be located within 61 m (200 ft) of a fault in which displacement has occurred in Holocene time (i.e., since the of the Pleistocene) and (2) facilities located in a 100-year floodplain must be constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood.		Solid Waste Disposal Act, amended (42 USC 6901, et seq.); 40 CFR Part 264, Subpart B	The RCRA requirement for generation, transportation, and storage of hazardous wastes may be applicable if RCRA hazardous wastes are detected at the site in concentrations above EPA criteria for hazardous characteristics in soil. Land disposal restrictions may be applicable if sufficient concentrations of particular hazardous wastes identified in 40 CFR Part 268 are store on-site. Missouri is an authorized state under RCRA, and Missouri State regulations replace federal regulations. for those federal standards for which Missouri has not yet received authorization, federal regulations will apply; therefore, both state and federal regulations must be evaluated.
	Facilities must be designed, constructed, maintained, and operated to minimize the possibility of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste (or constituents) to air, water, or surface water that could threaten human health or the environment. A contingency plan must be in place and emergency procedures must be implemented to minimize releases of hazardous wastes from a facility.		Solid Waste Disposal Act, amended (42 USC 6901, et seq.); 40 CFR Part 264, Subpart C	Such management will be considered in light of the CAMU rulemaking.

TABLE 3-3a

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE LANDFILL OU-2

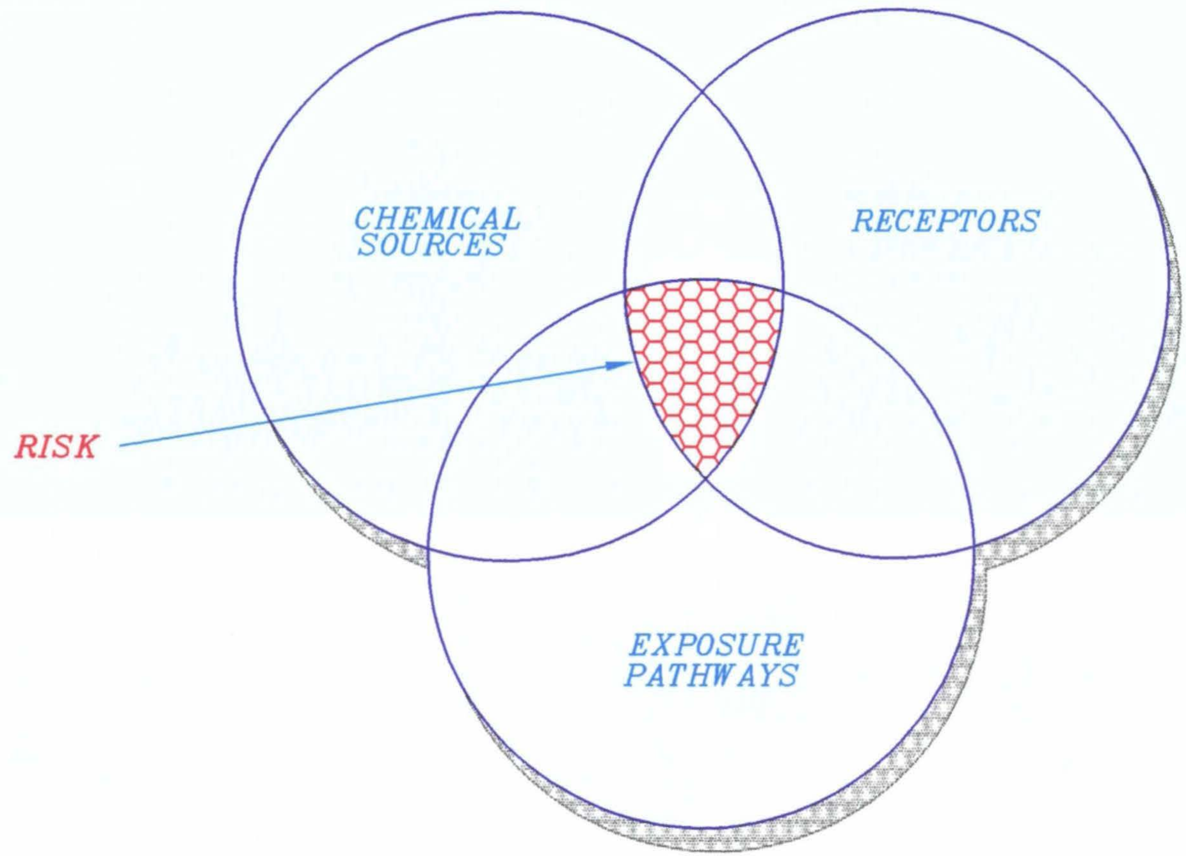
Actions	Requirement	Prerequisites	Citation	Comments
Waste Treatment Storage, or Disposal (continued)	Various requirements (e.g., for facility design, operation, and closure, as appropriate) are established for treatment, storage, and disposal of hazardous wastes.		Solid Waste Disposal Act, amended (42 USC 6901, et seq.); 40 CFR 264, Subpart E, Subpart F, Subpart G, Subpart H, Subpart K, Subpart L, Subpart M, Subpart N, Subpart O, Subpart P, and Subpart X	Such management will be considered in light of the CAMU rulemaking.

TABLE 3-3b

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR WEST LAKE SITE

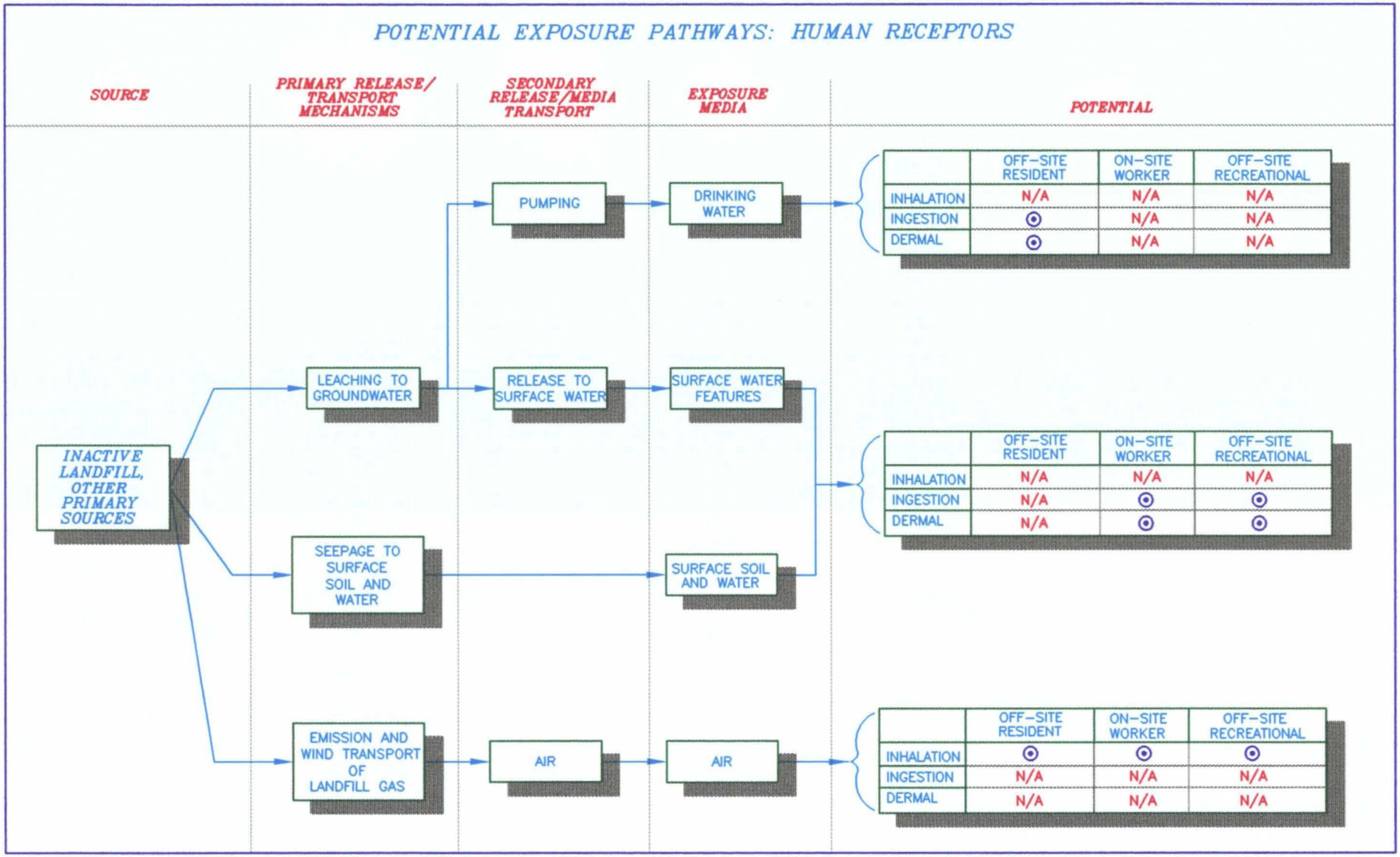
Actions	Requirement	Citation	Comments
Groundwater Monitoring	Municipal Solid Waste Landfill units must have a groundwater monitoring program in place capable of detecting constituents listed in Appendix I and Appendix II of 10 CSR 80-3.010 (8)(c).	10 CSR 80-3.010 (8)(c)	The Detection Monitoring Program is automatically upgraded to the Assessment Monitoring Program if a statistically significant increase over background concentrations of any listed constituent is identified. A corrective action measures monitoring program must be implanted if any Appendix II constituents is detected at a statistically significant level exceeding groundwater protection standards.
Waste Treatment Storage, and Disposal	Various requirements are identified for waste treatment, storage, and disposal facilities.	Missouri Hazardous Substance Waste Rules (10 CSR 24); Missouri Solid Treatment Waste Management Law (RSMo.storage, and 260.200 to 260.245) and Regulations Disposal (10 CSR 80); Missouri Hazardous Waste Management Law (RSMo. 260.350 to 260.552) and Regulations (10 CSR 25)	Such management will be considered in light of the CAMU rulemaking.

COMPONENTS OF RISK



CLIENT/PROJECT							
LAIDLAW WASTE SYSTEMS INC. WEST LAKE LANDFILL OPERABLE UNIT 2			Golder Associates DENVER, COLORADO			TITLE: COMPONENTS OF RISK	
DRAWN TMC	CHECKED CER	REVIEWED WEH	DATE APRIL 1995	SCALE NOT TO SCALE	FILE NO. 2848A031	JOB NO. 943-2848	DWG NO./REV.NO. A031

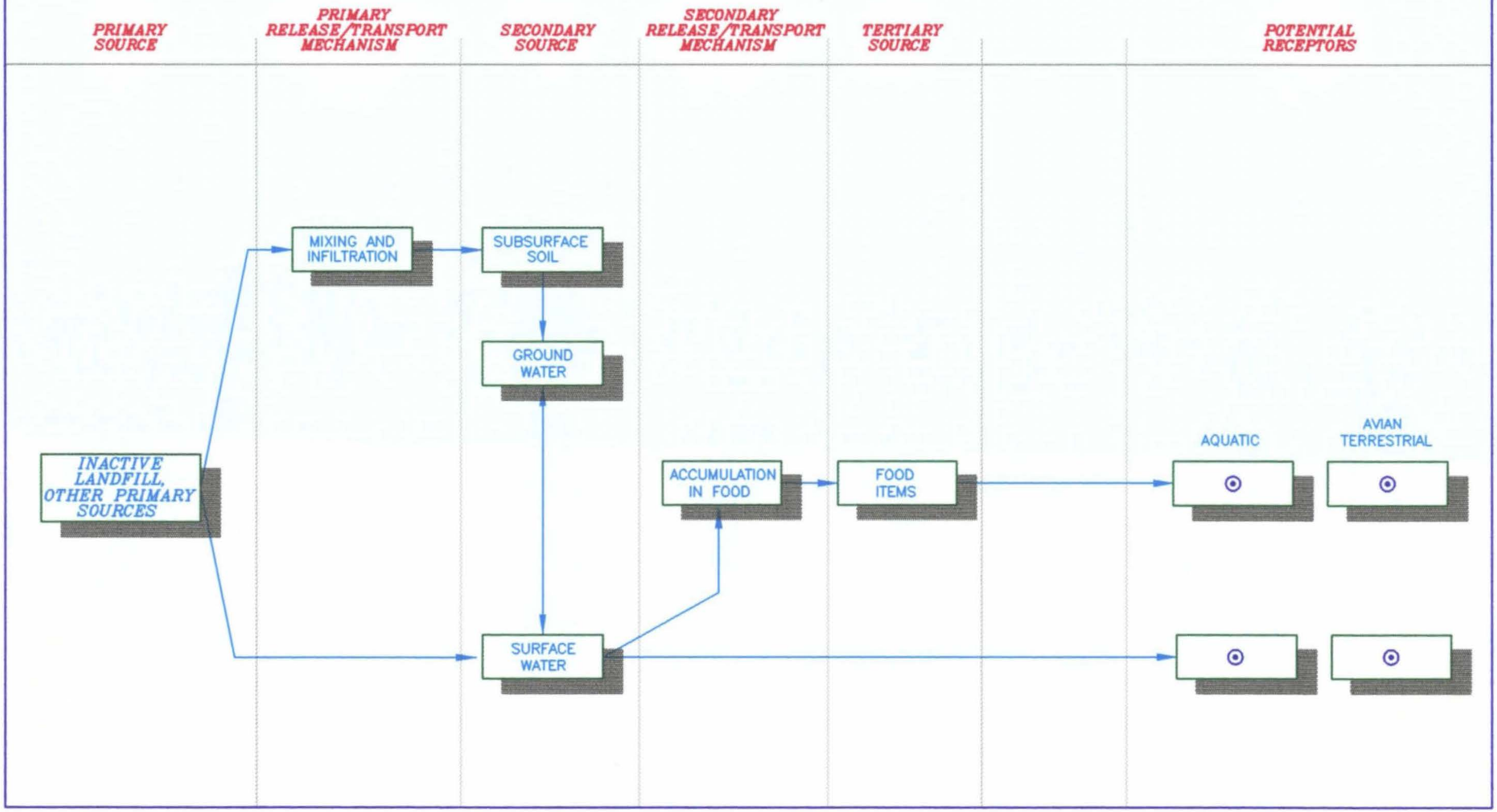
FIGURE 3-1



KEY: ⊙ PATHWAY TO BE EVALUATED N/A NOT APPLICABLE

CLIENT/PROJECT					TITLE
LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2	Golder Associates	DENVER, COLORADO		POTENTIAL EXPOSURE PATHWAYS HUMAN RECEPTORS
DRAWN TMC	CHECKED CER	REVIEWED WEH	DATE APRIL 1995	SCALE NOT TO SCALE	FILE NO. 2848A025
JOB NO. 943-2848	DWG NO./REV.NO. A025	FIGURE 3-2			

POTENTIAL EXPOSURE PATHWAYS: ECOLOGICAL RECEPTORS



KEY: ⊙ PATHWAY TO BE EVALUATED

CLIENT/PROJECT		TITLE
LAIDLAW WASTE SYSTEMS INC. WEST LAKE LANDFILL OPERABLE UNIT 2	Golder Associates DENVER, COLORADO	POTENTIAL EXPOSURE PATHWAYS ECOLOGICAL RECEPTORS

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO./REV.NO.	FIGURE
TMC	CER	WEH	APRIL 1995	NOT TO SCALE	2848A024	943-2848	A024	3-3

4.0 WORK PLAN RATIONALE

4.1 Work Plan Approach

As described in Section 1.0, this RI/FS Work Plan has been developed in accordance with EPA presumptive remedy and streamlined RI/FS guidance. The data requirements described in this Work Plan therefore are oriented toward source containment and potential exposure pathways outside the source areas. Based on the initial evaluation of site conditions presented in Section 3.0, existing data regarding site conditions is insufficient to adequately address the goals of the RI/FS (i.e., characterize the site, define site dynamics, define risks, and develop the remedial action). The following sections identify specific data needs and define the level of quality required to fulfill these goals for both the Remedial Investigation and the Feasibility Study.

4.2 Remedial Investigation Data Requirements

The following specific objectives for field activities have been developed for the West Lake OU-2 RI, based on the AOC requirements:

- Investigate and define site physical and biological characteristics;
- Define sources of contamination;
- Characterize site hydrogeologic conditions;
- Determine the quality of groundwater, surface water, and sediments; and,
- Develop a conceptual site model which identifies contaminant migration pathways and potential receptors.

To accomplish each of the stated specific objectives, it is necessary to review the level of information available and assess the data requirements for the objective. From this evaluation, the areas of insufficient data have been identified and a technical rationale has been developed outlining the work tasks necessary to obtain the required data. The following discussion will accomplish this review process and present the technical rationale for additional data collection activities. A detailed description of the work tasks that will be undertaken during the additional data collection activities is presented in Section 5.

4.2.1 Define Site Physical and Biological Characteristics

In order to define the site and surrounding area physical and biological characteristics, information concerning the physiography, geology, hydrology, demographics and specific physical characteristics will be required. A literature review, physical measurements, observations, and sampling efforts will be utilized to obtain these data.

Physical information needed to describe regional as well as site characteristics includes topography, local drainage patterns, surficial geology, soil types, geomorphological features, land use, and ecological setting. The biological information needed will include an analysis of the flora and fauna, critical habitats, and endangered species in the site vicinity. This information will assist in correlating regional information with site-specific conditions.

As summarized in Section 2, a preliminary literature review conducted as part of the scoping task for this RI/FS identified certain information about regional physiography, geology and hydrogeology. Previous investigations have provided information about certain site-specific conditions, including land use, site history and development, surficial geology, drainage patterns, and ecological setting. This information will be evaluated and supplemented by additional literature review to complete the regional physical description. A surficial geologic investigation will be performed to define site topography,landfill settlement, current drainage patterns, surficial geology, and existing cultural features. The surficial geologic investigation is described in Section 5.

The demographics of the region surrounding the site will also be evaluated. This information will be used in conducting the risk assessment. Demographic information was obtained during the preliminary literature review, and will be supplemented with additional literature review as part of the RI.

An ecological evaluation has been proposed for the site as part of the remedial investigation of OU-1. Following completion of this ecological assessment by McLaren/Hart, the results will be reviewed by Golder to determine whether this effort will be sufficient to meet the AOC requirements for OU-2.

4.2.2 Define Sources of Contamination

As part of the scoping process, information regarding the volume and nature of industrial wastes disposed of at the site, disposal practices, and analysis of historical aerial photographs has been reviewed. These records show that waste disposal at the site was generally governed by either St. Louis County or MDNR requirements. As discussed in Section 2.4.3.1, available information indicates that industrial wastes may have been deposited at the site by at least four companies prior to 1979. Potential liquid waste disposal areas have been inferred by the EPA (1989d and 1991a) based on an analysis of historical aerial photographs (Figure 2-8). Unknown factors include the chemical nature of liquids potentially disposed, the degree to which the wastes may have been altered since disposal, any waste migration, and the magnitude of possible contribution from sources other than areas where the wastes may have been disposed. Thus, there is the potential for isolated areas of industrial waste disposal within the West Lake Landfill.

Because the available information indicates that industrial wastes were disposed of on-site, future activities should focus on characterization of the nature and extent of potential sources of industrial materials within the landfill. Because the presumptive remedy at this site will include a landfill cap and gas collection (at a minimum), the scope of source area investigation can be targeted to obtain data necessary for the conceptual site model and predesign. To accomplish these goals several discrete efforts should be undertaken:

1) Investigate the potential for liquid wastes and sludges to have been disposed of in limited portions of the site. This investigation will entail completion of leachate wells to determine whether the previously inferred liquid waste disposal areas are distinctly different in chemical composition than other waste disposal areas, and will assist in determining whether leachate collection may be necessary;

2) Examine the extent and magnitude of landfill gas emissions across the landfilled areas. This investigation will be accomplished using soil gas survey techniques. In addition, a landfill gas survey will be conducted along the eastern boundary of the site to evaluate the potential for gas migration in this area;

3) Evaluate the area near monitoring well MW-F2 to determine the extent of the petroleum product impacts previously detected in this well. This investigation will entail the completion of additional borings and monitoring wells to determine the nature and extent of these impacts; and,

4) Evaluate the potential for leachate to have impacted the alluvial and/or bedrock aquifers. This investigation will entail the completion of monitoring wells downgradient of the landfill areas with a particular focus on inferred areas of industrial waste disposal.

4.2.4 Characterize Site Hydrogeologic Characteristics

The hydrogeologic characteristics of the site will be characterized to evaluate potential pathways for contaminant migration. The surface water bodies in the site vicinity include the Earth City stormwater retention pond and the north slough. There are also five permitted NPDES outfalls which discharge from the site. To adequately characterize the hydrologic conditions in the site vicinity, it will be necessary to assess the relationship between groundwater and surface water. and define the potential for site drainage features to impact surface water bodies. These objectives will be accomplished through completion of the surficial geologic investigation and updating of previously determined site drainage maps, and the comparison of groundwater levels with surface water levels to determine potential interrelationships. In addition, climatic data and information on more regionally significant surface water bodies (e.g., Missouri River) will be obtained and evaluated to determine potential influences on site hydrologic conditions.

Principal water bearing zones that could be impacted by historical landfill operations include the alluvium and the underlying limestone bedrock. Previous hydrogeologic investigations have focused primarily on alluvial groundwater, and have yielded partial information regarding background conditions, horizontal flow directions, vertical hydraulic gradients, velocity and the extent of site-related groundwater impacts. Previous investigations have generally not addressed hydrogeologic conditions in bedrock.

Previous investigations suggest that the regional groundwater flow direction in the alluvium is northwesterly towards the Missouri River. Modification of the topography from quarrying and landfilling in the site vicinity may have impacted surface water drainage and pre-existing groundwater recharge areas, which has likely impacted local groundwater flow conditions in the alluvium and upper limestone aquifer. The current network of monitoring wells is not sufficient to ascertain local groundwater flow direction in the vicinity of OU-2.

Site hydrogeologic conditions will be determined through a comprehensive investigation of the alluvial aquifer and underlying Salem/St. Louis limestone aquifer. This investigation will include the installation of clustered piezometers at interpreted background locations and across the OU-2 site. In addition, existing monitoring wells around the OU-1 site perimeter and other portions of the West Lake Landfill will be evaluated for inclusion into the hydraulic monitoring network for OU-2. The purpose of the hydraulic monitoring network will be to establish groundwater flow directions in the two principal stratigraphic units, evaluate vertical hydraulic gradients across the site and determine hydraulic parameters (e.g., hydraulic conductivity and effective porosity) for these units.

Once this initial hydrogeologic investigation has been completed it will be possible to propose a groundwater quality monitoring network for OU-2. The new piezometers will be installed to the same standards as monitoring wells. This will permit the use of a subset of these piezometers for the groundwater quality monitoring network. The groundwater quality monitoring network for OU-2 will be proposed to EPA in a technical memorandum attached to a Monthly Progress Report. This technical memorandum will be prepared following the initial characterization of site hydrogeologic conditions, but prior to the Site Characterization Summary Report.

The initial hydrogeologic investigation will also establish the physical characteristics of the alluvial and bedrock aquifers. More specifically, the drilling program will provide for sufficient data collection to permit accurate characterization of site stratigraphy including important characteristics such as facies changes, bedrock topography, geologic structural features, and hydraulic properties of the these units. A detailed description of the hydrogeologic investigation for OU-2 is included in Section 5.

4.2.6 Determine Groundwater Quality

The existing groundwater quality database for OU-2 requires updating and expansion to determine whether landfill operations may have adversely impacted groundwater quality in either of the principal stratigraphic units. As described in the previous section, the results from the initial hydrogeologic investigation will be evaluated to develop a groundwater quality monitoring network for OU-2. The proposed monitoring network will be designed to provide sufficient data to establish groundwater quality in the principal stratigraphic units at background locations as well as areas located downgradient of the identified source areas onsite. Depending on the nature of the data obtained from the initial hydrogeologic investigation, it may be prudent to incorporate some of the new and existing OU-1 monitoring wells into the OU-2 monitoring network. The details of the proposed groundwater quality monitoring network will be included in a technical memorandum, which will be submitted to EPA for review and approval. Following acceptance of the groundwater quality monitoring network by EPA, two rounds of groundwater quality monitoring will be conducted at the approved groundwater monitoring network (see Section 4.2.5).

The results from the initial hydrogeologic investigation and the groundwater monitoring program will be evaluated to determine potential contaminant migration pathways in the two principal stratigraphic units and the potential for leachate from the inactive landfill areas to have impacted groundwater quality in the site vicinity. This evaluation will also evaluate the potential for groundwater quality impacts to impact surface water bodies adjacent to the site. Ultimately, the results of the groundwater investigations conducted during the RI will be factored into the Conceptual Site Model, and used to determine whether remedial action will be necessary for groundwater.

4.2.7 Determine Surface Water and Sediment Quality

Currently, surface water bodies are limited to the Earth City stormwater retention pond, the slough located north of the site, and surface water runoff accumulated in depressions of the current landfill. Five NPDES permitted surface water discharge points onsite have been monitored in accordance with permit conditions and have been found to be in general compliance with permit limits. Previous investigations have included limited sampling of site surface water bodies. Although seeps have been detected along the northeast perimeter of the OU-2 site there has not been an effort to systematically identify seep locations and determine whether sediments in the vicinity may have been impacted.

To determine the extent of surface water and sediment contamination, it will be necessary to undertake an investigative program in the site vicinity. A seep survey will be conducted to identify potential sampling locations. A sampling program will be conducted at specific surface water bodies and confirmed seep locations. In addition to water quality sampling, physical data including water levels in discrete surface water bodies, drainage patterns on site, climatic records and river stage will be obtained. This investigative program will allow for determination of potential adverse impact from surface water or seeps, which will be factored into the Conceptual Site Model.

4.2.8 Determine Air Quality

Landfill gas has been sampled during previous investigations. The results compare favorably with typical landfill gas composition. To determine the potential for landfill gas to impact air quality on-site or off-site, a specific program will be undertaken as part of the RI. As part of the RI field activities, an air monitoring program will be implemented to evaluate air quality onsite. The details of this air monitoring program are presented in Section 5.

4.2.9 Develop Conceptual Site Model

The results from the RI investigative program will be evaluated to revise the preliminary Conceptual Site Model presented in this Work Plan. The CSM will identify potential source areas, impacted media, potential contaminant migration pathways, and potential receptors and provide an assessment of whether each of the exposure pathways are complete. The purpose of this CSM is to provide sufficient information to allow for assessment of risk not covered by the response actions contemplated in the EPA's presumptive remedy.

4.3 Remedial Investigation Data Quality Objectives

This section describes the data quality objectives for the RI tasks described above. Table 4-1 summarizes the RI data needs and data quality objectives. Analytical levels listed in the tables are described in *Data Quality Objectives for Remedial Response Activities, Volume I, Development Process* (EPA, 1987b). Analytical levels that may be required for the RI/FS at the site are summarized below.

Level I: Field Screening

This level is characterized by the use of portable instruments, such as an organic vapor analyzer (OVA), photoionization detector (PID), or scintillation detector, that can provide real-time data to assist in the optimization of samples for laboratory analysis and for health and safety monitoring. Qualitative data can be generated regarding the presence or absence of certain types of contaminants (i.e., volatile organic compounds) at sampling locations. Results are generally not chemical-specific and are not quantitative. Level I analyses will be utilized throughout the West Lake Landfill OU-2 RI.

Level II: Field Analyses

This level uses more sophisticated portable analytical instruments either on-site or in a mobile laboratory. Qualitative and quantitative data can be generated for certain compounds depending on the type of contaminant, sample matrix analytical procedures, and skills of the personnel. Level II field analyses will be used for selected field data acquisition for the West Lake Landfill OU-2 RI.

Level III: Laboratory Analyses

This level refers to analyses conducted by standard, laboratory procedures conducted in a laboratory. Level III analyses will be performed using primarily SW-846 methods. Enhanced data deliverables will support full data validation. Level III procedures will be used for all laboratory analyses conducted under the West Lake Landfill OU-2 RI Work Plan.

Existing data are insufficient to allow adequate identification of indicator parameters. As a result, initial samples for Level III analysis will be analyzed for parameters on the RCRA Subtitle D Appendix I list, as well as CLP Target Compound List (TCL) semi-volatile organic compounds and pesticides/PCBs. Certain radionuclides will also be included in the groundwater, surface water, and leachate sample analyte list. Table 4-2 lists the specific analytes for soil and sediment samples. Table 4-3 lists the specific analytes for liquid (groundwater, surface water, and leachate) samples. The list will be analyzed using primarily SW-846 methods. Initial samples will be analyzed for the complete parameter list appropriate for each media; the parameter list may be reduced if analytical results indicate that certain parameters or groups of parameters are not appropriate for analysis. Detection limits will be designed to meet ARARs and provide reliable data for use in the baseline risk assessment.

Data quality objectives (DQOs) are qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained in support of remedial response activities and agency decisions. To ensure that the data generated during the remedial response activities are adequate to support a decision, a clear definition of the objectives and the method by which decisions will be made must be established early in the planning of the remedial response activities.

The data type and quality must be sufficient to meet the overall objective of the West Lake Landfill OU-2 RI, which is to determine the nature and extent of the threat posed by the release, or threat of release, of hazardous substances, and to evaluate proposed remedies. The overall objective of the FS is to select the most cost-effective remedial alternative which mitigates threats to, and provides protection of, public health, welfare, and the environment. DQOs will be utilized throughout the process to ensure adequate data are collected.

Indicators of data quality include precision, accuracy, representativeness, completeness, and comparability (PARCC). According to the EPA (1987b), RI/FS sites are so different and information on overall measurements is so limited that it is not practical to set PARCC goals prior to initiation of work. However, CLP data has been found to be 80 to 85 percent complete, with completeness being defined as "the percentage of measurements made which are judged to be valid" (EPA, 1987b). For the West Lake Landfill OU-2 RI/FS, completeness of data will be considered acceptable if it is at least 85 percent complete. Completeness for Level I analyses is not critical; however, experience suggests that a Level I completeness of 90 percent is possible.

If data are found to be less than 85 percent complete, an analysis will be made to determine if the incomplete data allow for an adequate determination of site characterization, risk assessment, evaluation of alternatives, etc. If the data are complete, no corrective action will be required. If the data are inadequate, an evaluation will be made of the data gaps, and subsequent sampling will be conducted to fill those gaps. In all cases, the EPA will be consulted to allow for their input and recommendations.

The DQOs related to PARCC must be met to ensure that the data are of acceptable quality for the intended uses. In general, precision and accuracy specified in the analytical methods will provide acceptable levels of these parameters for all intended data uses. Acceptable precision and accuracy is most critical if concentrations of contaminants detected are close to the level of concern defined by the ARARs or are necessary for the baseline risk assessment. However, if analytical results are far above or below the level of concern, the data may be useful even when the precision and accuracy are outside the normally acceptable range.

In order to be considered representative, the sampling program (locations, sampling intervals, and sampling procedures) must be designed to ensure that the sample data accurately and precisely represent the site conditions. The objectives for comparability of data must be met by using standardized protocols and techniques to collect and analyze representative samples and in reporting analytical results.

4.4 Feasibility Study Data Requirements

Several investigative tasks will be performed to develop data necessary to develop suitable remedial alternatives in the Feasibility Study. Following is a list of these data collection activities.

1) An investigation will be conducted to determine the thickness, composition and physical properties of the existing soil cover for the inactive landfill areas.

2) The installation of leachate wells in the central portion of the inactive landfill areas will allow for determination of the areal extent and volume of leachate near inferred industrial waste disposal areas.

4.5 Feasibility Study Data Quality Objectives

Data quality objectives are not required by the EPA for Feasibility Study tasks as defined above. However, the inactive landfill soil cover investigation, and the investigation of the volume and extent of leachate within the landfill will be conducted as part of the RI and therefore will use appropriate Level I (field screening) data quality.

TABLE 4-1

REMEDIAL INVESTIGATION DATA QUALITY NEEDS AND OBJECTIVES

Investigative Activity	Data Application	Analytical Level	Critical Samples	Objectives	Contaminants of Concern	Required Detection Levels
Surficial Geologic Investigation	Site Characterization	Level I	None	Identify site features that will potentially affect RI/FS.	N/A	N/A
Aquifer Characterization	Site Characterization	Level II	None	Determine vertical/horizontal gradients, flow rates, and aquifer thickness.	N/A	Instrument detection levels
Geotechnical Sampling and Analysis	Site Characterization Remedial Design	Level III	None	Determine structural integrity of landfill liner and cover.	N/A	ASTM standards
Sediment Sampling and Analysis	Site Characterization Risk Assessment	Level III	Background Field Duplicate Rinsate Blank	Determine impacts to surface soils and sediment.	VOCs, SVOCs, metals, cyanide, pesticides	Risk-based detection levels; ARARs
Surface Water Sampling and Analysis	Site Characterization Risk Assessment Remedial Design	Level III	Background Field Duplicate Rinsate Blank Trip Blank	Characterize surface water. Determine remedial options for surface water.	VOCs, SVOCs, metals, cyanide, TPH, pesticides, indicator parameters	Risk-based detection levels; ARARs
Groundwater Sampling and Analysis	Site Characterization Risk Assessment Remedial Design	Level III	Background Field Duplicate Rinsate Blank Trip Blank	Determine impacts to groundwater. Determine need for groundwater remediation.	VOCs, SVOCs, radionuclides, metals, cyanide, pesticides, TPH	Risk-based detection levels; ARARs
Landfill Gas	Site Characterization	Level III	Field Duplicate Rinsate Blank Trip Blank	Determine constituent concentrations. Determine extent of hydrocarbon contamination.	VOCs, methane	Risk-based detection levels; ARARs

TABLE 4-1

REMEDIAL INVESTIGATION DATA QUALITY NEEDS AND OBJECTIVES

Investigative Activity	Data Application	Analytical Level	Critical Samples	Objectives	Contaminants of Concern	Required Detection Levels
Air Monitoring	Health and Safety	Level I	None	Determine volatile and oxygen concentrations for health and safety purposes.	VOCs, Oxygen, methane	Instrument detection levels
Leachate	Site Characterization Risk Assessment Remedial Design	Level III	Field Duplicate Rinsate Blank Trip Blank	Characterize leachate. Determine remedial options for leachate.	VOCs, SVOCs, metals, cyanide, TPH, pesticides indicator parameters	Risk-based detection levels; ARARs
Subsurface Soil Sampling and Analysis	Site Characterization Risk Assessment Remedial Design	Level III	Field Duplicate Rinsate Blank Trip Blank	Characterize impacts to subsurface soils in vicinity of MW-F2. Determine remedial options	Benzene, toluene, ethylbenzene, xylene, total petroleum hydrocarbons	Risk-based detection levels; ARARs

N/A = Not applicable.

TABLE 4-2

SOIL AND SEDIMENT ANALYTE LIST

Metals
Antimony, Total
Arsenic, Total
Barium, Total
Beryllium, Total
Boron, Total
Cadmium, Total
Calcium, Total
Chromium, Total
Cobalt, Total
Copper, Total
Iron, Total
Lead, Total
Magnesium, Total
Manganese, Total
Mercury, Total
Nickel, Total
Selenium, Total
Silver, Total
Sodium, Total
Thallium, Total

Metals, continued
Vanadium, Total
Zinc, Total
General Parameters
Cyanide, Total
Sulfide
Total Petroleum Hydrocarbons
Total Dissolved Solids (TDS)
Total Organic Carbon (TOC)
Radionuclides
Gross Alpha
Gross Beta
Radium-226
Thorium-230
Uranium-234, 235, and 238
Volatile Organic Compounds (VOCs)
Acetones
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane

VOCs, continued
Bromoform (Tribromomethane)
Bromomethane (Methyl bromide)
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
Chloromethane (Methyl chloride)
1,2-Dibromo-3-chloropropane
Dibromochloromethane (Chlorodibromomethane)
1,2-Dibromoethane (Ethylene dibromide)
trans-1,4-Dichloro-2-butene
1,2-Dichlorobenzene (o-DCB)
1,4-Dichlorobenzene (p-DCB)
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane

TABLE 4-2

SOIL AND SEDIMENT ANALYTE LIST

VOCs, continued
cis-1,3-Dichloroethene
trans-1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methyl ethyl ketone (2-Butanone)
Methyl iodide (iodomethane)
Methyl isobutyl ketone (4-Methyl-2-pentanone)
Methylene bromide (Dibromomethane)
Methylene chloride (Dichloromethane)
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1.2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,2,3-Trichloropropane

VOCs, continued
Vinyl acetate
Vinyl chloride
Xylenes
Semivolatile Organic Compounds (SVOCs)
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Carbazole
p-Chloro-m-cresol (4-Chloro-3-methylphenol)
4-Chloroaniline
bis(2-Chloroethoxy)methane
bis(2-Chloroethyl)ether

SVOCs, continued
bis(2-Chloroisopropyl)ether
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
m-Cresol (3-Methylphenol)
o-Cresol (2-Methylphenol)
p-Cresol (4-Methylphenol)
Dibenzo(a,h)anthracene
Dibenzofuran
1,3-Dichlorobenzene (m-DCB)
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate
Dimethyl phthalate
2,4-Dimethylphenol
Di-n-butyl phthalate
4,6-Dinitro-o-cresol (2-methyl-4,6-dinitrophenol)
2,4-Dinitrophenol

TABLE 4-2

SOIL AND SEDIMENT ANALYTE LIST

SVOC, continued
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octyl phthalate
bis(2-Ethylhexyl) phthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol

SVOCs, continued
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorbenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Pesticides and Polychlorinated Biphenyls (PCBs):
Aldrin
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
alpha-Chlordane
gamma-Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT

Pesticides and PCBs, continued
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

TABLE 4-3

LIQUID ANALYTE LIST

Metals
Antimony, Total and Dissolved
Arsenic, Total and Dissolved
Barium, Total and Dissolved
Beryllium, Total and Dissolved
Boron, Total and Dissolved
Cadmium, Total and Dissolved
Calcium, Total and Dissolved
Chromium, Total and Dissolved
Cobalt, Total and Dissolved
Copper, Total and Dissolved
Iron, Total and Dissolved
Lead, Total and Dissolved
Magnesium, Total and Dissolved
Manganese, Total and Dissolved
Mercury, Total and Dissolved
Nickel, Total and Dissolved
Selenium, Total and Dissolved
Silver, Total and Dissolved
Sodium, Total and Dissolved
Thallium, Total and Dissolved

Metals continued
Vanadium, Total and Dissolved
Zinc, Total and Dissolved
General Parameters
Ammonia as N
Chemical Oxygen Demand (COD)
Chloride
Cyanide, Total
Fluoride
Hardness, Total (Calculated)
Nitrate/Nitrite
Phosphorus, Total
Sulfate as SO4
Sulfide
Total Petroleum Hydrocarbons
Total Dissolved Solids (TDS)
Total Organic Carbon (TOC)
Radionuclides
Gross Alpha, Total and Dissolved
Gross Beta, Total and Dissolved
Radium-226, Total and Dissolved

Radionuclides, continued
Thorium-230, Total and Dissolved
Uranium-234, 235, and 238, Total and Dissolved
Volatile Organic Compounds (VOCs)
Acetone
Acrylonitrile
Benzene
Bromochloromethane
Bromodichloromethane
Bromoform (Tribromomethane)
Bromomethane (Methyl bromide)
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
Chloromethane (Methyl chloride)
1,2-Dibromo-3-chloropropane
Dibromochloromethane (Chlorodibromomethane)
1,2-Dibromoethane (Ethylene dibromide)
trans-1,4-Dichloro-2-butene

TABLE 4-3

LIQUID ANALYTE LIST

VOCs, continued
1,2-Dichlorobenzene (o-DCB)
1,4-Dichlorobenzene (p-DCB)
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloroethene
trans-1,3-Dichloroethene
Ethylbenzene
2-Hexanone
Methyl ethyl ketone (2-Butanone)
Methyl iodide (iodomethane)
Methyl isobutyl ketone (4-Methyl-2-pentanone)
Methylene bromide (Dibromomethane)
Methylene chloride (Dichloromethane)
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane

VOCs, continued
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
1,2,3-Trichloropropane
Vinyl acetate
Vinyl chloride
Xylenes
Semivolatile Organic Compounds (SVOCs)
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
4-Bromophenyl phenyl ether

SVOCs, continued
Butyl benzyl phthalate
Carbazole
p-Chloro-m-cresol (4-Chloro-3-methylphenol)
4-Chloroaniline
bis(2-Chloroethoxy)methane
bis(2-Chloroethyl)ether
bis(2-Chloroisopropyl)ether
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
m-Cresol (3-Methylphenol)
o-Cresol (2-Methylphenol)
p-Cresol (4-Methylphenol)
Dibenzo(a,h)anthracene
Dibenzofuran
1,3-Dichlorobenzene (m-DCB)
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate

TABLE 4-3

LIQUID ANALYTE LIST

SVOCs, continued	SVOCs, continued	Pesticides and PCBs, continued
Dimethyl phthalate	4-Nitroaniline	4,4'-DDD
2,4-Dimethylphenol	Nitrobenzene	4,4'-DDE
Di-n-butyl phthalate	2-Nitrophenol	4,4'-DDT
4,6-Dinitro-o-cresol (2-methyl-4,6-dinitrophenol)	4-Nitrophenol	Dieldrin
2,4-Dinitrophenol	N-Nitrosodi-n-propylamine	Endosulfan I
2,4-Dinitrotoluene	N-Nitrosodiphenylamine	Endosulfan II
2,6-Dinitrotoluene	Pentachlorophenol	Endosulfan sulfate
Di-n-octyl phthalate	Phenanthrene	Endrin
bis(2-Ethylhexyl) phthalate	Phenol	Endrin aldehyde
Fluoranthene	Pyrene	Endrin ketone
Fluorene	1,2,4-Trichlorbenzene	Heptachlor
Hexachlorobenzene	2,4,5-Trichlorophenol	Heptachlor epoxide
Hexachlorobutadiene	2,4,6-Trichlorophenol	Methoxychlor
Hexachlorocyclopentadiene	**Pesticides and Polychlorinated Biphenyls (PCBs)**	Toxaphene
Hexachloroethane	Aldrin	Aroclor-1016
Indeno(1,2,3-cd)pyrene	alpha-BHC	Aroclor-1221
Isophorone	beta-BHC	Aroclor-1232
2-Methylnaphthalene	delta-BHC	Aroclor-1242
Naphthalene	gamma-BHC (Lindane)	Aroclor-1248
2-Nitroaniline	alpha-Chlordane	Aroclor-1254
3-Nitroaniline	gamma-Chlordane	Aroclor-1260

5.0 DESCRIPTION OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

Five primary tasks have been identified for the OU-2 RI/FS, based on the SOW. These tasks are:

Task 1:	Scoping (Work Plan)
Task 2:	Site Characterization (Remedial Investigation)
Task 3:	Treatability Studies (as needed)
Task 4:	Development and Screening of Remedial Alternatives (Feasibility Study)
Task 5:	Detailed Analysis of Alternatives (Feasibility Study)

These tasks are described in the following sections. A schedule for task completion is provided in Section 6.

5.1 Task 1: Scoping

The scoping phase of the West Lake Landfill OU-2 RI/FS consists of development of this Work Plan. The RI/FS scoping task includes preparation and EPA review of the draft Work Plan, and preparation and EPA approval of the final Work Plan. The Draft Sampling and Analysis Plan (Appendix A) is submitted to EPA simultaneous with submission of the final Work Plan. The Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) comprise the Sampling and Analysis Plan.

5.2 Task 2: Site Characterization

During site characterization, the sampling and analysis plan (SAP) developed during project planning will be implemented. Field data will be collected and analyzed to determine if the site poses a threat to human health or the environment. The rationale for specific components of the RI data collection activities are expanded in this section. More specifically, Section 5 describes the details of the field investigative tasks, including the scope of activities and general methodology that will be utilized. After completion of the field program, a Site Characterization Summary Report and an RI Report will be prepared and submitted to the EPA.

The site characterization will include the following specific subtasks:

- Define site physical and biological characteristics:
  - Surficial geologic investigation;
  - Ecological evaluation;
  - Collection of additional information on site physical characteristics and demographics;
- Characterize site hydrogeologic characteristics:
  - Evaluation of existing well integrity;
  - Initial hydrogeologic investigation;
  - Technical memorandum recommending groundwater quality monitoring network;
  - Determine groundwater quality;
- Define sources of contamination:
  - Leachate sampling and analysis;
  - Landfill gas characterization;
  - Investigation of potential petroleum impacts near well MW-F2;
  - Evaluation of potential impacts to groundwater;
- Determine surface water and sediment quality:
  - Surface water sampling and analysis;
  - Seep survey, sampling, and analysis;
- Determine air quality;
- Site characterization reporting;
- Receipt of EPA's baseline risk assessment, allowing preparation of the RI report; and,
- RI reporting.

The site characterization and RI reports will consist of submitting draft reports for EPA review, and submitting final reports for EPA approval. Reporting tasks are specified in the SOW. The site characterization field tasks, described in detail below, are activity requirements specified in the SOW.

The primary objectives of the OU-2 RI is to collect data in and adjacent to OU-2 regarding contaminant characteristics, occurrence, pathways, and transport mechanisms. Data from the RI will be evaluated to assess risk to human health and the environment and to determine the most feasible remedial options (including no action).

A detailed description of the methods and procedures to be used during the investigative tasks is presented in the Field Sampling Plan (FSP) of the Sampling Analysis Plan (SAP), which is Appendix A to this Work Plan. Chemical laboratory methods, analytical levels and laboratory quality assurance/quality control (QA/QC) methods are discussed in the Quality Assurance Project Plan (QAPP) (Appendix A-2).

The following sections summarize field investigation subtasks.

5.2.1 Define Site Physical and Biological Characteristics

This subtask includes three separate work activities to be performed; i) surficial geologic investigation, ii) ecological evaluation, and iii) collection of additional information on site physical characteristics and demographics.

Surficial Geologic Investigation

A surficial geologic investigation will be performed to define surficial geology, current drainage patterns, site geomorphology, site cultural features, and to evaluate landfill settlement.

The surficial geologic investigation will entail several discrete field tasks:

1) Surficial Geologic Mapping: To identify soil conditions, bedrock outcrops, stratigraphic relationships, local landforms, and surface water bodies. This effort will result in the development of a detailed geologic map of the site.

2) Evaluation of Landfill Settlement: Historical aerial photographs will be reviewed to determine the rate of landfill settlement for the inactive landfill.

The end product of these field activities will be the development of detailed topographic and geologic maps which will aid in the planning for later site characterization activities.

Ecological Evaluation

The SOW for OU-2 requires that an ecological evaluation be performed to evaluate the flora and fauna of the site, identify critical habitats and endangered species, and describe the ecological setting of the site and the surrounding area. The SOW for OU-1 requires a similar ecological evaluation. Following completion of the ecological evaluation by McLaren/Hart for OU-1, the data will be reviewed to determine if this evaluation is sufficient to meet the AOC requirements for OU-2. If the OU-1 ecological evaluation is determined to be insufficient, supplemental activities will be performed to address the outstanding issues.

Collection of Additional Information on Site Physical Characteristics and Demographics

As part of the initial RI activities, additional information will be obtained to assist in characterization of the site. This activity will include a literature review and field verification of information as required. The data collection activities will focus on updating geologic, hydrogeologic, hydrologic, ecologic, climatic, land use and demographic information for the site and surrounding area. The end product of this activity will be a more complete database for the physical and demographic description of the site, which will also assist in refining the Conceptual Site Model.

5.2.2 Define Sources of Contamination

As discussed in Sections 2 and 4, industrial wastes may have been disposed of at the site. The investigative activities will focus on characterization of the nature and extent of potential sources of hazardous substances within the landfill. Because the presumptive remedy at the site will include a landfill cap and gas collection (at a minimum), the scope of the source area investigation can be targeted to obtain data necessary for the CSM and predesign. To accomplish these goals several discrete field activities will be undertaken:

1) Leachate sampling and analysis;
2) Landfill gas characterization;
3) Investigation of potential petroleum impacts near well MW-F2; and,
4) Evaluation of potential impacts to groundwater.

The following discussion provides a detailed description of the field activities that will be performed for each task.

5.2.2.1 Leachate Sampling and Analysis

In an effort to determine whether past disposal practices may have resulted in source areas for contamination in the inactive landfill, a subsurface investigation will be performed consisting of the installation of leachate risers in the inactive landfill. Based on the identified source areas shown on Figure 2-8, six leachate risers will be installed within these areas and will be sampled if leachate is present. Following is a description of the proposed location for each of these leachate risers.

The leachate risers will be designated LR-100 through LR-105. Leachate risers LR-100 through LR-102 will be installed in potential source area targets in the inactive landfill on the western portion of the site. Leachate risers LR-103 and LR-104 will be installed east of the inactive landfill in the central portion of the site in two potential source area targets. Leachate riser LR-105 will be installed near the top of the inactive landfill. The proposed locations for these six leachate risers are shown on Figure 5-1.

This investigative program will involve advancement of test borings in the six proposed locations, and subsequent evaluation to determine whether a leachate riser should be installed at each location. The test borings will be advanced at each location using hollow stem auger drilling methods and samples of the waste materials/soils will be obtained using split-spoon or wireline samplers. The test borings will be completed to the base of the waste materials and care will be taken to avoid penetration through the landfill liner, if present. After completion of the test boring to the base of the waste, the boring will be checked for leachate level. If leachate is encountered in the test boring, a leachate riser will be completed. If leachate is not encountered in that test boring, an assessment will be made as to whether the boring should be abandoned. Borehole abandonment will be accomplished by using a cement/bentonite grout or bentonite pellets to backfill the boring. During drilling of the test boring samples of any landfill cap material and/or liner material will be retained for geotechnical analysis. The suite of geotechnical tests to be performed on these samples is summarized in Section 5.2.4.1.2.

The leachate risers will be constructed using 2-inch PVC materials. The screened interval will extend from the base of the leachate to the top of the leachate, or to a maximum length of 10 feet, whichever is less. Care will be taken to avoid screening above the top of the leachate layer to prevent the development of landfill gas condensate in the riser. Landfill gas condensate could alter the chemistry of the leachate samples. The completed leachate risers will be surveyed for vertical and horizontal control to allow for determination of leachate levels.

Following completion of the leachate riser installations, each of the leachate risers will be sampled for the parameter list identified in Table 4-3.

5.2.2.2 Landfill Gas Characterization

A field investigation will be conducted to determine the extent and magnitude of landfill gas emissions across the inactive landfill areas. This investigation will consist of two components:

1) An investigation of landfill gas emissions along the crest of the inactive landfill areas biased toward the proposed leachate riser locations; and,

2) An investigation of potential landfill gas migration along the western boundary of the inactive landfill. Both investigation methodologies are described below.

Investigation of Landfill Gas Emissions Within The Inactive Landfill

A soil gas survey will be conducted at 10 locations within the boundary of the inactive landfill areas (Figure 5-2). The location of these soil gas sampling points will be biased toward the source area targets and the crest of the landfill where landfill gas should accumulate, if present. These sampling points will be driven to a depth of approximately 3 feet below ground surface using standard soil gas sampling techniques. Soil gas samples will be obtained from each location by evacuating the soil gas from the sampling probe with a pump and directing the gas sample into a Tedlar bag or Summa canister. The gas samples will be submitted for laboratory analysis of landfill gas parameters, which are listed in Table 5-2. The sampling points will be abandoned by backfilling the annulus with bentonite. The results from this investigation will provide a preliminary indication of landfill gas chemistry and will provide data for the CSM.

Investigation of Potential Landfill Gas Migration Along The Western Boundary of The Inactive Landfill

Landfill gas has the potential to migrate along the western side of the inactive landfill near St. Charles Rock Road. To address this issue, a soil gas survey will be conducted along the access road on the west side of the inactive landfill to determine whether gas migration may be occurring. Soil gas sampling points will be advanced every 250 feet along this edge of the landfill (approximately ten sampling locations, Figure 5-2). This soil gas survey is intended to provide qualitative information only. This investigation will use a combustible gas indicator to measure gas concentrations. The soil gas barhole probes will be advanced to a depth of approximately 3 feet below ground surface before a sample is withdrawn.

5.2.2.3 Investigation of Potential Petroleum Impacts Near Well MW-F2

Previous investigations have shown that landfill gas near monitoring well MW-F2 may have been impacted by petroleum products. To address this issue, a subsurface investigation will be conducted to determine the extent and magnitude of the impacts. The investigation will include the following components:

1) Installation of piezometer PZ-303-AS;
2) Completion of four borings to characterize soil impacts;
3) Installation of a leachate riser; and,
4) Soil, leachate, and groundwater sampling.

Piezometer PZ-303-AS will be installed adjacent to well MW-F2 and will be constructed using the methodology presented in Section 5.2.4. The piezometer is intended to monitor the water table interface and will be constructed to allow for monitoring of floating product (if present) as well as collection of groundwater samples. Four soil borings will be completed in the vicinity of PZ-303-AS as shown in Figure 5-3. These soil borings will be continuously sampled to termination at the water table, and one soil sample will be collected from each boring for laboratory analysis. The purpose of these borings is to evaluate the lateral extent of vadose zone impacts in this vicinity.

A leachate riser will be installed at the top of the berm of the inactive landfill, near PZ-303-AS. The leachate riser will be installed to determine whether a source of the petroleum products observed at MW-F2 is present within the landfill. The leachate riser, LR-105 will be installed using the methods described earlier in this section. Samples of leachate from LR-105 and groundwater samples from PZ-303-AS will be submitted for laboratory analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX) as well as total petroleum hydrocarbons (TPH). The selected soil samples will also be submitted to the project laboratory for BTEX and TPH analyses. The results from this investigation will be reviewed to determine whether any additional investigation will be required to determine the source or extent of the petroleum impacts in this vicinity.

5.2.2.4 Evaluation of Impacts to Groundwater

As part of the effort to define source areas it will be important to determine whether industrial waste disposal on-site may have impacted groundwater quality. As described in Section 4.2.4, a groundwater quality monitoring network will be proposed to EPA following completion of the initial hydrogeologic investigation for OU-2. One of the primary objectives of this monitoring network will be to provide an adequate monitoring network downgradient of the identified source areas. Thus, the final groundwater monitoring network will be designed to provide data on the potential for industrial leachate to have impacted groundwater quality onsite and address the potential for a leachate plume to migrate beyond the site boundary. Both of these design objectives for the groundwater monitoring network must be met to determine whether the site remedy should address groundwater remediation onsite and/or offsite.

5.2.3 Characterize Site Surface Water Hydrologic Conditions

In order to adequately characterize hydrologic conditions in the site vicinity it will be necessary to define drainage patterns, assess the relationship between surface water and groundwater, and evaluate the potential for site drainage features to impact the identified surface water bodies. This task will be accomplished by completion of the following activities:

1) Evaluation of the monitoring records for NPDES permitted discharges;

2) Evaluation of climatic data, river stage data, water quality records for the Missouri River and any other regional surface water quality records;

3) Evaluation of hydraulic head data from the hydrogeologic investigation to determine the potential for groundwater discharge to surface water bodies; and,

4) Establish staff gauges at significant surface water bodies in the site vicinity, and monitor water level on a monthly basis.

5.2.4 Characterization of Site Hydrogeology

Groundwater beneath the site exists in alluvial deposits and bedrock. Bedrock is the uppermost saturated unit in the eastern portion of the site. In the western portion of the site, saturated alluvium overlies the bedrock. Previous hydrogeologic investigations have focused primarily on alluvial groundwater conditions, but have not yielded complete information regarding horizontal flow directions, vertical hydraulic gradients or groundwater velocity. In addition, previous groundwater investigations have not fully addressed hydrogeologic conditions in the bedrock.

Data from previous investigations suggest that the regional groundwater flow is northwesterly towards the Missouri River. Modification of the local topography from quarrying and landfilling may have impacted surface water drainage and pre-existing groundwater recharge areas, which has likely impacted local groundwater flow conditions in the alluvial and upper bedrock aquifers. For example, leachate collection in the active landfill is designed to maintain a gradient into the landfill from the surrounding bedrock. The current network of monitoring wells is not sufficient to adequately determine local groundwater flow direction in the vicinity of OU-2.

During the RI, the hydrogeologic framework beneath the site will be characterized by installing piezometers in the alluvial aquifer and in the bedrock. Aquifer characteristics will be determined by conducting slug tests and packer tests. Horizontal flow directions and possible vertical gradients will be identified by water level measurements in proposed piezometers and selected existing monitoring wells. Only monitoring wells determined by an OU-1 well survey to be reliable will be used.

The hydrogeologic investigation will also define the physical characteristics of the alluvial and bedrock aquifers beneath the site. Specifically, the drilling program will allow for accurate characterization of stratigraphic units including features such as facies changes, bedrock topography, geologic structural features and hydraulic properties of these units.

The proposed piezometers to be installed as part of OU-2 activities will be installed to EPA and MDNR standards for installation of groundwater monitoring wells, which will permit the use of a subset of these piezometers for the groundwater quality monitoring network. The ground water quality monitoring network will be proposed to EPA in a technical memorandum following the initial characterization of site hydrogeologic conditions.

5.2.4.1 Initial Hydrogeologic Characterization

To conduct the initial hydrogeologic investigation, a significant investigative program will be undertaken. The first step of this investigation will be installation of a series of clustered piezometers to evaluate groundwater flow directions in each principal stratigraphic unit to determine physical characteristics and hydraulic relationships.

The piezometers to be installed during the RI will be designated "100-," "200-," and "300-" series. The "100-" and "200-" series piezometers will characterize the bedrock (Salem/St. Louis, Warsaw, and Keokuk Formations, if encountered) and the alluvium across the eastern part of the site. The "300-" series piezometers will characterize the bedrock (Salem/St.Louis Formation) and the alluvium across the western and southern parts of the site. The "100-," "200-," and "300-" series piezometers to be installed are shown in Figure 5-2.

Piezometers will be labeled with a prefix "PZ" and will include a suffix designation specific to the formation being monitored. An "A" suffix will be used if the piezometer is completed into the alluvium. An "S" suffix will be used if the piezometer is completed into the Salem\St. Louis

Limestone. A suffix "K" will be used if the piezometer is completed into the Keokuk Limestone. An additional suffix will designate whether the piezometer is completed into the shallow (i.e., "S"), intermediate (i.e., "I"), or deep (i.e., "D") portion of the aquifer.

Four borings will be completed into the limestone sequence below the shales of the Warsaw Shale (assumed to be Keokuk Formation); 4 borings will be completed at the bottom of the Salem/St. Louis Limestone; 23 borings will be completed at the top of the Salem/St. Louis Limestone. Sixteen borings will be drilled in the alluvium, of which 10 will be completed at the water table, 4 will be completed in the intermediate portion of the aquifer, and 2 of the borings will be completed at the bottom of the aquifer. The relatively high number of borings intended for the Salem/St. Louis Limestone reflects the lack of existing data for this aquifer. The alluvial aquifer has been well-characterized and does not require significant additional data.

The rationale for each of the proposed borings and their designations is presented below. The borings are grouped by clusters where appropriate.

PZ-100-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. PZ-100-SS is intended to be used in conjunction with PZ-115-SS and PZ-208-SS in triangulation of water levels along the northern end of the sanitary landfill.

PZ-100-SD Boring intended to be completed in the lower portion of the Salem/St. Louis Limestone. PZ-100-SD will be used in conjunction with PZ-100-SS and PZ-100-KS to determine vertical gradients along the northern end of the sanitary landfill.

PZ-100-KS Boring intended to be completed into the limestone sequence below the shales of the Warsaw Shale (assumed to be Keokuk Formation). This boring will be continuously sampled during drilling and will be geophysically logged upon reaching total depth. PZ-100-KS will be used in conjunction with PZ-100-SS and PZ-100-SD to determine vertical gradients along the northern end of the sanitary landfill.

PZ-101-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-101-SS is intended to be used in conjunction with PZ-102-SS and PZ-200-SS in triangulation of water levels along the northeastern portion of the sanitary landfill.

PZ-102-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-102-SS is intended to be used in conjunction with PZ-101-SS and PZ-200-SS in triangulation of water levels along the northeastern portion of the sanitary landfill.

PZ-103-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-103-SS is intended to be used in conjunction with PZ-201-SS and PZ-202-SS in triangulation of water levels along the eastern portion of the sanitary landfill.

PZ-104-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. PZ-104-SS is intended to be used in conjunction with PZ-105-SS and PZ-203-SS in triangulation of water levels along the southeastern portion of the sanitary landfill.

PZ-104-SD Boring intended to be completed in the lower portion of the Salem/St. Louis Limestone. PZ-104-SD will be used in conjunction with PZ-104-SS and PZ-104-KS to determine vertical gradients along the southeastern edge of the sanitary landfill.

PZ-104-KS Boring intended to be completed into the limestone sequence below the shales of the Warsaw Shale (assumed to be Keokuk Formation). This boring will be continuously sampled during drilling and will be geophysically logged upon reaching total depth. A permanent surface casing will be placed in the borehole prior to drilling the upper shale sequence of the Warsaw Shale, to isolate the St. Louis and Salem Limestone units from the underlying limestone sequence of the Warsaw Shale and the Keokuk Limestone. PZ-104-KS will be used in conjunction with PZ-104-SS and PZ-104-SD to determine vertical gradients along the southeastern end of the sanitary landfill.

PZ-105-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-105-SS is intended to be used in conjunction with PZ-106-SS, PZ-204-SS and LCS-2 in triangulation of water levels near the active landfill.

PZ-106-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. PZ-106-SS is intended to be used in conjunction with PZ-105-SS, PZ-204-SS, and LCS-2 in triangulation of water levels near the active landfill.

PZ-106-SD Boring intended to be completed in the lower portion of the Salem/St. Louis Limestone. PZ-106-SD will be used in conjunction with PZ-106-SS and PZ-106-KS to determine vertical gradients along the southern edge of the sanitary landfill.

PZ-106-KS Boring intended to be completed 150 feet below the top of the Warsaw Shale (assumed to be into the Keokuk Formation). This boring will be continuously sampled during drilling and will be geophysically logged upon reaching total depth. A permanent surface casing will be placed in the borehole prior to drilling the upper shale sequence of the Warsaw Shale, to isolate the St. Louis and Salem Limestone units from the underlying sequence of the Warsaw Shale and the Keokuk Limestone. PZ-106-KS will be used in conjunction with PZ-106-SS and PZ-106-SD to determine vertical gradients along the southern end of the sanitary landfill.

PZ-107-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-107-SS will be used in conjunction with PZ-106-SS, LCS-4, and PZ-205-SS in triangulation of water levels near the southwestern corner of the sanitary landfill.

PZ-108-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-108-SS is intended to be used in conjunction with PZ-109-SS and PZ-206-SS in triangulation of water levels near the old quarry.

PZ-109-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-109-SS is intended to be used in conjunction with PZ-108-SS and PZ-206-SS in triangulation of water levels near the old quarry.

PZ-110-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. The location of PZ-110-SS was selected to maintain an approximate 400 lineal foot spacing and to assist in defining the location of the edge of the alluvial valley.

PZ-111-SD Boring intended to be completed in the lower portion of the Salem/St. Louis Limestone. No shallow boring is necessary at this cluster location because wells MW-F1S and MW-F1D already exist. PZ-111-SD will be used in conjunction with MW-F1S, MW-F1D, and PZ-111-K to determine vertical gradients along the western edge of the sanitary landfill.

PZ-111-KS Boring intended to be completed into the limestone sequence below the shales of the Warsaw Shale (assumed to be Keokuk Formation). This boring will be continuously sampled during drilling and will be geophysically logged upon reaching total depth. PZ-111-KS will be used in conjunction with PZ-106-SD, MW-F1S, and MW-F1D to determine vertical gradients along the western edge of the sanitary landfill. A permanent surface casing will be placed in the borehole prior to drilling the upper shale sequence of the Warsaw Shale, to isolate the St. Louis and Salem Limestone units from the underlying sequence of the Warsaw Shale and the Keokuk Limestone.

PZ-112-AS Shallow boring intended to be completed 10 feet below the water table in the alluvium. This boring will be continuously sampled during drilling. Alluvial boring intended to determine the potentiometric surface between the inactive landfill to the west and the sanitary landfill to the east.

PZ-113-AS Shallow boring intended to be completed 10 feet below the water table in the alluvium. PZ-113-AS is intended to be used in conjunction with PZ-207-AS and S-84 in triangulation of water levels between the demolition landfill and the sanitary landfill.

PZ-113-AD Boring intended to be completed at the base of the alluvium. PZ-113-AD will be used in conjunction with PZ-113-AS to determine vertical gradients between the demolition landfill and the sanitary landfill.

PZ-113-SS Boring intended to be completed 50 feet into the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-113-SS will be used in conjunction with PZ-113-AS and PZ-113-AD to determine vertical gradients between the demolition landfill and the sanitary landfill.

PZ-114-AS Shallow boring intended to be completed 10 feet below the water table in the alluvium. This boring will be continuously sampled during drilling. PZ-114-AS is intended to provide potentiometric surface data north of the sanitary landfill.

PZ-115-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-115-SS is intended to be used in conjunction with PZ-100-SS and PZ-208-SS in triangulation of water levels along the northern end of the sanitary landfill.

PZ-200-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-200-SS is intended to be used in conjunction with PZ-101-SS and PZ-102-SS in triangulation of water levels along the northeastern portion of the sanitary landfill. PZ-200-SS will also be used to determine landfill gas concentrations.

PZ-201-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-201-SS is intended to be used in conjunction with PZ-103-SS and PZ-202-SS in triangulation of water levels along the eastern portion of the sanitary landfill. PZ-201-SS will also be used to determine landfill gas concentrations.

PZ-202-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-202-SS is intended to be used in conjunction with PZ-103-SS and PZ-201-SS in triangulation of water levels along the eastern portion of the sanitary landfill. PZ-202-SS will also be used to determine landfill gas concentrations.

PZ-203-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-203-SS is intended to be used in conjunction with PZ-104-SS and PZ-105-SS in triangulation of water levels along the southeastern portion of the sanitary landfill. PZ-203-SS will also be used to determine landfill gas concentrations.

PZ-204-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-204-SS is intended to be used in conjunction with PZ-105-SS, PZ-106-SS and LCS-2 in triangulation of water levels near the active landfill.

PZ-205-AS Shallow boring intended to be completed 10 feet below the water table in the alluvium. PZ-205-AS will be used in conjunction with PZ-205-SS to determine vertical gradients near the southwestern corner of the sanitary landfill.

PZ-205-SS Deep boring intended to be completed 50 feet into the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-205-SS will be used in conjunction with PZ-106-SS, PZ-107-SS, and LCS-4 in triangulation of water levels near the southwestern corner of the sanitary landfill.

PZ-206-SS Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-206-SS is intended to be used in conjunction with PZ-108-SS and PZ-109-SS in triangulation of water levels near the old quarry.

PZ-207-AS Shallow boring intended to be completed 10 feet below the water table in the alluvium. This boring will be continuously sampled during drilling. PZ-207-AS is intended to define the hydrogeologic conditions between the demolition landfill and the sanitary landfill as well as to allow triangulation of water levels between the two landfills in conjunction with PZ-113-AS and S-84.

PZ-208-SS — Shallow boring intended to be completed 10 feet below the water table in the Salem/St. Louis Limestone. This boring will be continuously sampled during drilling. PZ-208-SS is intended to be used in conjunction with PZ-100-SS and PZ-115-SS in triangulation of water levels along the northern end of the sanitary landfill.

PZ-300-AS,AI,AD — One cluster of wells will be installed near the southern edge of the site, adjacent to wells D-91, I-50, and S-80. This cluster will provide background groundwater quality data.

PZ-300-SS — One upper bedrock piezometer will be installed near wells D-91, I-50, and S-80 to provide vertical gradient information between the alluvium and the bedrock in this background setting.

PZ-301-SS — One upper bedrock piezometer will be installed near the southern edge of the soil borrow area. This piezometer will provide supplemental background data for the upper and lower Salem/St. Louis Formation, respectively.

PZ-302-AS,AI — One cluster of piezometers will be installed near well S-75. This cluster will provide hydraulic head data immediately upgradient of the landfilled materials.

PZ-303-AS — This piezometer will be installed adjacent to MW-F2, which has exhibited petroleum odors. The shallow completion interval coincides with the shallow completion interval for MW-F2.

PZ-304-AS,AI — A cluster of piezometers will be installed along the western boundary of the site, near abandoned well I-56. This cluster will be used to determine the hydraulic head near the Earth City stormwater retention feature, to compare water levels to leachate levels within the landfilled materials, and to determine vertical gradients at the edge of the facility.

PZ-305-AS,AI — A cluster of wells will be installed near the center of the site in an area identified as an underground storage tank (UST) site. This cluster will be used to triangulate water levels across the western portion of the site.

5.2.4.1.1 Piezometer Drilling Methodology

All piezometer boreholes will initially be drilled with a truck mounted rig equipped with at a minimum 3 1/4 inside diameter (I.D.) hollow stem augers (HSA) or solid stem augers (SSA) until the target depth or bedrock is encountered. The boreholes to be advanced into bedrock will be drilled with a minimum I.D. of 8 inches. Permanent surface casing will be placed in three deep boreholes (PZ-104-KS, PZ-106-KS, and PZ-111-KS) prior to penetrating through the upper shale sequence in the Warsaw Shale.

Bedrock drilling will be accomplished with a truck mounted rotary rig capable of drilling with air or water. The rotary rock boring diameter will be a minimum I.D. of 6 inches.

5.2.4.1.2 Sampling and Logging of Subsurface Material

Soil Sampling and Logging

Sampling of the alluvium will allow for direct observation of the overburden material beneath the site. This will allow for determining screen intervals and allow for the proper sizing of the sand pack.

The deepest boring in each piezometer cluster will be sampled continuously by split-spoon samplers (alluvium and loess), and wireline samplers (bedrock). The borings to be sampled continuously are identified in Table 5-1. The overburden material descriptions will include geologic origin where appropriate, blow counts (if samplers are driven), and color (Munsell color chart). The overburden samples will be classified according to the Unified Soil Classification System using ASTM Methods D2487 and D2489 on standard geologic boring logs.

Geologic boring logs will include overburden material descriptions, drilling and sampling methods, sample depth intervals, land surface elevations, and total depth of the boring.

Soil samples from the site borings will be archived for later geotechnical testing as described below. During borehole construction of the "300-" series alluvial monitoring wells, one soil sample corresponding to the screened interval will be obtained and analyzed for Total Organic Carbon (TOC). TOC data has a direct correlation to potential migration of dissolved organic compounds and will therefore assist in determining transport via groundwater.

In order to properly evaluate the geotechnical properties of the overburden materials, the following laboratory testing of selected overburden samples will be conducted:

Geotechnical Testing	ASTM Method Number	Estimated Number of Tests
Grain Size (Sieve and Hydrometer)	D442	35
Atterberg Limits	D4318	35
Moisture Content	D2216	27
Standard Proctor	D698	4
Remold Permeability	D5084	2
Undisturbed Permeability	D5084	10
Dry Density	D2937	27

The drilling logs, field data sheets, and logbooks generated during the hydrogeologic investigation will be copied for submittal as appendices in the site characterization report.

Bedrock Sampling and Logging

Bedrock characterization will be accomplished utilizing rock coring techniques. Coring will allow for precise stratigraphic control of the underlying bedrock and will define aquifer thickness and characteristics. Direct observation of the rock core samples allows identification of the geologic properties of the rock such as fracture zones which may behave as preferred groundwater flow pathways. Core samples will allow for selection of packer test intervals and determination of screen intervals.

Geophysical Borehole Logging

Geophysical logging of the four deep (i.e., approximately 350 feet deep) bedrock borings targeted for the limestone sequence below the shales of the Warsaw Shale (assumed to be Keokuk Formation) will assist in the hydrogeologic characterization. If core and cutting samples retrieved during drilling are insufficient to confidently define the aquifer lithology and thickness, a borehole geophysics program will be implemented. The hydrogeologic objectives of the borehole geophysical program will include correlation and definition of aquifer or other lithologic units; estimation of aquifer properties such as porosity and permeability; and an assessment of the physical properties associated with the materials surrounding the borehole. This would be in addition to proposed geotechnical testing described above.

The borehole geophysical methods for this investigation may include, as necessary, natural gamma ray, caliper, resistivity, neutron, and gamma-gamma density.

5.2.4.1.3 Piezometer Installation

The piezometer screen intervals will enable delineation of the uppermost and underlying aquifers at the site. Based on current knowledge of the general hydrogeologic regime at the West Lake Landfill, it is anticipated that the shallow piezometer at each cluster east of the alluvial valley will be screened at the water table; the middle piezometer will be screened at the bottom of the limestone aquifer (immediately above the Warsaw Shale); and the deep piezometer will be screened in limestone 20 feet below the shales of the Warsaw Shale. For clusters in the alluvial valley, it is anticipated that the shallow alluvial piezometer will be screened at the water table, the intermediate alluvial piezometer will be screened near the center of the aquifer, and the deep alluvial piezometers will be screened immediately above the limestone bedrock. The shallow bedrock piezometer will be screened approximately 50 feet into the limestone aquifer. Table 5-1 lists the proposed piezometers, the corresponding aquifer to be monitored, and estimated depth of the piezometer.

In general, piezometer screened intervals will be placed across the bottom 10 feet of each borehole. The exceptions will be for four proposed piezometers located east of the facility (PZ-200-SS, PZ-201-SS, PZ-202-SS, and PZ-203-SS), which will be constructed with a modified design. Specifically the screen will extend from approximately 10-feet below ground surface to approximately 10-feet below the water table. These piezometers may be used for both groundwater and gas monitoring purposes.

In addition, the existing groundwater monitoring well 1201 near the active landfill will be modified and redesignated 1201-SS. This existing open hole completed well will be modified to a water table piezometer. The bottom of the existing well will be backfilled with grout consistent with Missouri well construction rules and appropriate EPA guidance. The estimated depth of 1201-SS will be 145 feet.

Piezometer materials and installation will be in accordance with the Missouri and EPA accepted standards. The Missouri Well Construction Rule CSR 23-4.060 and appropriate EPA guidance will be followed, to provide opportunity to utilize selected piezometers as monitoring wells.

The bedrock piezometers, due to their proposed depths, will be constructed of 2-inch diameter, 10-feet long (minimum), 0.010-inch factory slotted, schedule 80 PVC screen. Flush thread schedule 80 PVC riser pipe will be connected to the screen and will extend from 2 to 2.5 feet above the ground surface. The alluvial piezometers will be constructed identically, except schedule 40 PVC components will be used.

5.2.4.1.4 Piezometer Surveying

A land surveyor registered in the state of Missouri will determine the location and elevations of all piezometers. Borings will be located to the nearest 0.1 foot and elevations of the top of inner casings of the piezometers will be measured to 0.01 foot. All elevation measurements, grid patterns and coordinates must be established and used consistently throughout the investigation and referenced to North American Datum (NAD) 1983 and National Geodetic Vertical Datum (NGVD) 1929 or North American Vertical Datum (NAVD) 1988.

Surveyed elevations and coordinates will be utilized in preparing geological contour maps and groundwater contour maps.

5.2.4.1.5 Piezometer Development

Piezometers will be developed in order to ensure that drilling fluids and solids are removed from the gravel pack and formation, and to ensure hydraulic communication between the well and the formation.

All piezometers will be developed in accordance with the Missouri Well Construction Rule 10CSR 23-4.070 and appropriate EPA guidance. The piezometers will be developed by an electrically operated staged impeller submersible pump; a nitrogen-gas operated downhole bladder pump; a filtered compressed air system; a teflon, PVC, or stainless steel bailer; in conjunction with a fitted surge block. Water must move both in and out of the filter pack during development.

Development water will be discharged into the on-site leachate retention pond.

5.2.4.2 Aquifer Testing

Aquifer characteristics will be obtained for piezometers in order to provide a hydrogeologic conceptual model for the site. Aquifer testing will include packer tests in bedrock prior to piezometer completion, and slug tests in piezometers after completion.

Constant Head Injection Packer Testing

Constant head injection packer tests will be conducted in the four deep boring locations (PZ-100-KS, PZ-104-KS, PZ-106-KS, and PZ-111-KS) prior to piezometer installation in order to determine horizontal flow velocity of the bedrock aquifer. Packer test intervals will be determined from visual observation of the bedrock core samples and from geophysical logs. Packer tests are anticipated to be conducted at fracture zones in the bedrock units, as well as relatively unfractured zones to provide an upper and lower limit to hydraulic conductivity.

Slug Tests

Slug tests will be conducted in all of the piezometers in order to evaluate the horizontal hydraulic conductivity of the formation adjacent to the screened interval. Slug tests will be performed by either the addition of a known volume of clean, distilled water to the piezometer, the addition of a decontaminated rod (slug) capable of creating a known rise in water level in the piezometer or the removal of a known volume of water. Slug tests will be performed once in each piezometer shortly after completion. Slug tests will continue until water levels have reached at least 80 percent of the static water.

5.2.4.3 Water Level Survey

Water level measurements will be made subsequent to installation of the piezometers. These data will be used to aid in defining the groundwater flow regime at the site.

Water level measurements will be performed on the new piezometers and selected existing groundwater monitoring wells.

A site-wide well integrity survey will be conducted as part of OU-1 RI/FS activities in order to determine which of the currently existing monitoring wells may be incorporated into the site monitoring network. The currently existing site wells which are deemed usable will also be incorporated in the site-wide water level survey.

Monthly water level measurement will be performed beginning with completion of all "100-" and "200-" series piezometers and continuing for 12 months after completion of all "300-" series piezometers. Concurrently, fluid levels will be obtained from the four leachate collection sumps (LCS-1 through LCS-4) in the active landfill, one leachate well (Q71), ten gas wells (W-1 through W-10), and four gas collection manholes (GC-1 through GC-4). All fluid levels will be obtained on the same day, if possible.

A precipitation gauge capable of measuring precipitation events greater than 0.01 inch will be installed at an appropriate location on-site concurrent with, or prior to, installation of the piezometers. Data from the gauge will be used to interpret fluctuations in potentiometric level(s) on-site throughout the site characterization period.

U.S. Army Corps of Engineers daily stream flow data for the Missouri River at St. Charles will be obtained for the same one-year period as the groundwater level measurements.

At the conclusion of the physical portion of the hydrogeologic investigation a technical memorandum will be prepared providing the technical rationale for the proposed groundwater quality monitoring network. This technical memorandum will identify the piezometers that will be used as monitoring wells as part of the site-wide monitoring network.

5.2.5 Determine the Nature and Extent of Groundwater Contamination

The nature and extent of groundwater contamination will be determined using the EPA approved groundwater monitoring network for the site. It is anticipated that the groundwater monitoring network will be comprised of selected existing site wells and new monitoring wells installed for the OU-1 RI, as well as selected piezometers from the hydrogeologic investigation for OU-2. Once the final groundwater monitoring network is installed and the wells are developed, two rounds of groundwater sampling will be conducted. The target period for these sampling rounds is provided in Section 7. The groundwater sampling rounds will be conducted using EPA and MDNR approved sampling methods.

Groundwater samples from the first sampling round will be submitted to the project laboratory for the parameters specified in Table 4-3. Following evaluation of the first round data, a site-specific parameter list will be developed and proposed to EPA for the second round of ground water sampling.

The proposed groundwater quality monitoring network will be designed to provide sufficient data to establish groundwater quality in the principal stratigraphic units at background locations as well as areas located downgradient of the identified source areas onsite. The results of the hydrogeologic investigation and the groundwater monitoring program will be evaluated to determine potential contaminant migration pathways in the two principal stratigraphic units and the potential for leachate from the identified source areas to have impacted groundwater quality in the site vicinity. This evaluation will also evaluate the potential for groundwater quality impacts to affect surface water bodies.

5.2.6 Determine the Nature and Extent of Surface Water, Seep and Sediment Contamination

To determine the extent of surface water and sediment contamination, it will be necessary to undertake field sampling activities. The following are the principal tasks and methods that will be used to complete this sampling program.

1) Conduct a seep survey to determine the location of flowing seeps. According to the *Dictionary of Scientific and Technical Terms* (Parker, 1994), a seep is defined as an area, generally small, where water (or leachate) percolates slowly to the land surface. The seep survey will be conducted once, after a 0.1-inch in 24-hour storm event, and identify up to ten seeps. Each seep location will be staked, photo-documented and assigned a unique sample location code (SP-01, etc.). Seep discharge at each of the defined seep locations will be estimated at the time of the sampling event.

2) Collect one water sample and one sediment sample from each of the defined seep locations. Sample collection methods will comply with EPA protocols. These samples will be submitted to the project laboratory for analysis of the parameters shown on Tables 4-2 and 4-3.

3) Collect one surface water and sediment sample from two of the Earth City Storm Water Retention Ponds (southwest of the inactive landfill, and south of the monitoring well cluster consisting of S-80, I-50, and D-91) and submit these samples to the project laboratory for analysis of the parameter list specified in Tables 4-2 and 4-3.

Following review of the laboratory results an assessment will be made to determine whether additional sampling may be required.

5.2.7 Determine the Nature and Extent of Air Impacts

To determine the potential for landfill gas to impact air quality, a specific program will be undertaken as part of the RI field activities. More specifically, air quality will be monitored and recorded at each investigative location and sampling point using a combustible gas indicator and an FID. The results from the air quality monitoring program will be evaluated on an ongoing basis to determine whether significant landfill gas concentrations are being observed during field work.

The results from the air monitoring program will be evaluated in the RI to determine the potential for adverse impact from landfill gas.

5.2.8 Site Characterization Deliverables

As described in Section 4.2.5, the results of the physical characterization portion of the hydrogeologic investigation and recommendations for the final groundwater monitoring network will be submitted to EPA as part of the Physical Characterization Technical Memorandum. A preliminary Site Characterization Summary Report will be prepared and submitted to EPA prior to preparation of the Baseline Risk Assessment by EPA. The RI Report will be prepared once the Baseline Risk Assessment has been received from EPA. Following are the deliverables that will be submitted to EPA following completion of the RI field activities.

5.2.8.1 Site Characterization Summary Report

The Site Characterization Summary Report will review the investigative activities that have taken place, and describe and display data documenting the location and characteristics of surface and subsurface features. This report will provide data concerning impacted media, including the location, types and concentrations of contaminants. A preliminary interpretation of potential sources of the detected contamination as well as potential contaminant migration pathways will also be provided.

5.2.8.2 Remedial Investigation Report

An RI report will be prepared and submitted to EPA for review and approval. The RI report will summarize the results of field activities to characterize the site, sources of contaminants, nature and extent of contaminants, associated impacts, and the fate and transport of the contaminants.

5.3 Task 3: Treatability Studies

The application of the presumptive remedy for OU-2 may require one or more response actions that would include a treatment component; e.g., leachate treatment, groundwater treatment, or landfill gas treatment. In addition, if the results of the RI indicate that environmental media not covered under the presumptive remedy present significant risks to human health or the environment, treatment may be required.

Following completion of the Final RI Report, a technical memorandum analyzing the need for treatability studies will be prepared and submitted to EPA. If treatability studies are required for this project, the following submittals would be prepared for EPA's review and approval:

- Identification of Candidate Technologies Memorandum;
- Treatability Testing Work Plan;
- Treatability Study Sampling and Analysis Plan;
- Treatability Study Site Health and Safety Plan; and,
- Treatability Study Evaluation Report.

The scope of these potential additional submittals and schedule are presented in the AOC SOW.

5.4 Feasibility Study

The Feasibility Study will conform to Section 121 of SARA, the NCP as amended (March 1990), the FS guidance as amended, and relevant State and Federal policies. The FS will consist of the following three tasks:

- Task 4 - Development and Screening of Remedial Alternatives;
- Task 5 - Detailed Analysis of Remedial Alternatives; and,
- Task 6 - Feasibility Study Report.

5.4.1 Task 4: Development and Screening of Remedial Alternatives

This task constitutes the first stage of the FS and is comprised of nine interrelated subtasks. The goal is to develop and evaluate remedial alternatives, each of which would achieve the remedial objectives, for additional screening and review. The results of the streamlined risk assessment will be considered throughout the evaluation process.

As discussed previously, the AOC indicates that the Presumptive Remedy for CERCLA Municipal Landfills (1993a) will be the response action. The presumptive remedy for CERCLA municipal landfills relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate and affected groundwater at the perimeter of the landfill may be implemented as part of the presumptive remedy. For those impacted environmental media not covered under the presumptive remedy. remedial alternatives will be developed. Additional remedial alternatives may be developed and screened to address any potential hot spots identified during the RI. This development and analysis will also follow recommendations provided in EPA presumptive remedy guidance. As part of this process, the "no action" alternative will be included in the list of potential remedial alternatives.

The following nine subtasks define the sequence of activities and submittals that will comprise this FS work task.

- Subtask 4a:

  Develop Remedial Alternatives. A range of appropriate waste management options will be developed that ensure protection of human health and the environment. This development will occur concurrently with site characterization.

- Subtask 4b:

  Refine and Document Remedial Action Objectives. Site-specific remedial action objectives will be reviewed and modified, if necessary. The revised site-specific remedial action objectives shall be documented in a technical memorandum entitled Refined Remedial Action Objectives that will be reviewed and approved by EPA. The refined remedial action objectives shall specify the contaminants and media of interest, exposure pathways and receptors, and an acceptable contaminant level or range or levels (at particular locations for each exposure route).

- Subtask 4c:

  Develop General Response Actions. General response actions will be developed for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination, to satisfy the remedial action objectives.

- Subtask 4d:

  Identify Areas or Volumes of Media. Areas of volumes of media to which general response actions may apply will be identified.

- Subtask 4e:

  Identify and Screen Remedial Technologies. Technologies applicable to each general response action will be identified and evaluated to eliminate those that cannot be implemented. The general response actions will be refined to specify remedial technology types. Technology process options for each of the technology types will be identified either concurrent with the identification of technology types, or following the screening of the considered technology types.

Process options will be evaluated on the basis of effectiveness, implementability, and cost factors to select and retain one or, if necessary, more representative processes for each technology type. The reasons for eliminating alternatives will be specified.

- Subtask 4f:

  Assemble Alternatives. Selected representative technologies will be assembled into alternatives for each affected medium. Together, all of the alternatives will represent a range of treatment and containment combinations that will address site remediation. The reasons for eliminating alternatives during the preliminary screening process will be specified.

- Subtask 4g:

  Refine Alternatives. The remedial alternatives will be refined, taking into account contaminant volume, proposed process, and sizing of critical unit operations. Site-specific remediation objectives for each chemical in each medium will also be modified as necessary to incorporate any applicable risk assessment information presented in the Baseline Risk Assessment report. Additionally, action-specific ARARs will be updated as necessary.

- Subtask 4h:

  Conduct Screening Evaluation of Each Alternative. The final screening process will be performed based on short and long-term aspects of effectiveness, implementability, and relative cost. Generally, this screening process is only necessary when there are many feasible alternatives available for detailed analysis. If necessary, the screening of alternatives shall be conducted to assure that only the alternatives with the most favorable composite evaluation of all factors are retained for further analysis. As appropriate, the screening shall preserve the range of treatment and containment alternatives that was initially developed. The range of remaining alternatives will include options that use treatment technologies and permanent solutions to the maximum extent practicable.

- Subtask 4i:

  Alternatives Development and Screening Deliverables. A report entitled Development and Screening of Remedial Alternatives will be prepared summarizing the work performed in and the results of each task above, including an alternatives array summary for EPA review and approval. This deliverable at a minimum will document the methods, rationale, summary of the assembled alternatives and their related action-specific ARARs, and results of the alternatives screening process including the identification of the action-specific ARARs for the alternatives that remain after screening.

5.5 Task 5: Detailed Analysis of Remedial Alternatives

The remedial alternatives identified above will be subjected to a detailed analysis as part of the FS. The FS will be prepared after the RI and risk assessment are completed, and will be based upon the results of these studies. As previously discussed, the RI/FS is an iterative process and additional RI work may be warranted as the FS progresses.

A detailed analysis of remedial alternatives will be conducted consisting of an analysis of each option against a set of nine evaluation criteria and a comparative analysis of all options using the same evaluation criteria as a basis for comparison.

5.5.1 Apply Nine Criteria and Document Analysis

The following nine evaluation criteria will be applied to the assembled remedial alternatives:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and,
- Community acceptance.

For each alternative the following will be provided:

- A description of the alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative; and,
- A discussion of the individual criterion assessment.

5.5.2 Compare Alternatives Against Each Other and Document the Comparisons of Alternatives

A comparative analysis will be performed between the remedial alternatives by using the nine evaluation criteria as a basis of comparison. Identification and selection of the preferred alternative are reserved by EPA. A technical memorandum entitled Comparison of Remedial Alternatives will be submitted to EPA for review and approval which provides a comparative analysis of the alternatives.

5.6 Task 6 - Detailed Analysis Deliverables Feasibility Study (FS) Report

A Draft FS Report will be prepared for EPA review and comment. This report, as ultimately adopted or amended by EPA, provides a basis for remedy selection by EPA and documents the development and analysis of remedial alternatives. The Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (OSWER Directive 9355.3-01, October 1988) will be utilized for an outline of the report format and the required report content. A Final FS report will be prepared which will incorporate EPA comments. This Final FS Report will be submitted for EPA approval.

5.7 Feasibility Study Data Collection

To facilitate initiation of Feasibility Study activities, a landfill cap investigation will be undertaken during the Remedial Investigation field program to obtain data that will be useful for evaluation of remedial alternatives. The landfill cap investigation program will determine the existing cap thickness and its physical properties over the inactive landfill. The data collection program will be performed using a hand auger to collect soil samples for geotechnical testing as well as measurement of existing cap thickness. The investigative program will be conducted using a 200-foot grid spacing over the capped area of the inactive landfill (Figure 5-5). Data obtained from this investigation will be useful in establishing parameters for HELP modeling (i.e., potential leachate generation), as well as for development and evaluation of remedial alternatives for the site.

TABLE 5-1

RATIONALE OF PROPOSED PIEZOMETERS
REMEDIAL INVESTIGATION

Piezometer	Aquifer to be Characterized	Zone to be Characterized	Estimated Depth (Feet)	Sampling Requirements	Estimated Alluvial Interval	Estimated Bedrock Interval	Estimated Depth to Groundwater
PZ-100-SS	Salem/St. Louis Limestone	Water Table	150	Continuous from 140 to 150'	0-80'	80-150'	140'
PZ-100-SD	Salem/St. Louis Limestone	Bottom of Aquifer	263	Continuous from 253 to 263'	0-80'	80-263'	140'
PZ-100-KS	Keokuk Limestone*	Top of Aquifer	353	Continuous	0-80'	80-353'	140'
PZ-101-SS	Salem/St. Louis Limestone	Water Table	140	Continuous	0-65'	65-140'	130'
PZ-102-SS	Salem/St. Louis Limestone	Water Table	145	Continuous	0-60'	60-145'	135'
PZ-103-SS	Salem/St. Louis Limestone	Water Table	145	Continuous	0-40'	40-145'	135'
PZ-104-SS	Salem/St. Louis Limestone	Water Table	155	Continuous from 145 to 155'	0-25'	25-155'	145'
PZ-104-SD	Salem/St. Louis Limestone	Bottom of Aquifer	243	Continuous from 233 to 243'	0-25'	25-243'	145'
PZ-104-KS	Keokuk Limestone*	Top of Aquifer	333	Continuous	0-25'	25-333'	145'
PZ-105-SS	Salem/St. Louis Limestone	Water Table	170	Continuous	0-20'	20-170'	160'
PZ-106-SS	Salem/St. Louis Limestone	Water Table	165	Continuous from 155 to 165'	0-30'	30-165'	155'
PZ-106-SD	Salem/St. Louis Limestone	Bottom of Aquifer	199	Continuous from 189 to 199'	0-30'	30-199'	155'
PZ-106-KS	Keokuk Limestone*	Top of Aquifer	289	Continuous	0-30'	30-289'	155'
PZ-107-SS	Salem/St. Louis Limestone	Water Table	140	Continuous	0-50'	50-140'	130'
PZ-108-SS	Salem/St. Louis Limestone	Water Table	135	Continuous	0-35'	35-135'	125'
PZ-109-SS	Salem/St. Louis Limestone	Water Table	135	Continuous	0-50'	50-135'	125'
PZ-110-SS	Salem/St. Louis Limestone	Water Table	138	Continuous	0-65'	65-138'	128'

* or limestone sequence below the shales of the Warsaw Shale. See text for discussion.

TABLE 5-1

RATIONALE OF PROPOSED PIEZOMETERS
REMEDIAL INVESTIGATION

Piezometer	Aquifer to be Characterized	Zone to be Characterized	Estimated Depth (Feet)	Sampling Requirements	Estimated Alluvial Interval	Estimated Bedrock Interval	Estimated Depth to Groundwater
PZ-111-SD	Salem/St. Louis Limestone	Bottom of Aquifer	205	Continuous from 195 to 205'	0-65'	65-205'	24'
PZ-111-KS	Keokuk Limestone*	Top of Aquifer	295	Continuous	0-65'	65-295'	24'
PZ-112-AS	Alluvium	Water Table	35	Continuous	0-35'	--	25'
PZ-113-AS	Alluvium	Water Table	35	Continuous from 25 to 35'	0-35'	--	25'
PZ-113-AD	Alluvium	Bottom of Aquifer	90	Continuous from 80 to 90'	0-90'	--	25'
PZ-113-SS	Salem/St. Louis Limestone	50' into Bedrock	140	Continuous	0-90'	90-140'	25'
PZ-114-AS	Alluvium	Water Table	30	Continuous	0-30'	--	20'
PZ-115-SS	Salem/St. Louis Limestone	Water Table	130	Continuous	0-65'	65-130'	120'
PZ-200-SS	Salem/St. Louis Limestone	Water Table	130	Continuous	0-75'	75-130'	120'
PZ-201-SS	Salem/St. Louis Limestone	Water Table	130	Continuous	0-50'	50-130'	120'
PZ-202-SS	Salem/St. Louis Limestone	Water Table	130	Continuous	0-25'	25-130'	120'
PZ-203-SS	Salem/St. Louis Limestone	Water Table	170	Continuous	0-20'	20-170'	150'
PZ-204-SS	Salem/St. Louis Limestone	Water Table	155	Continuous	0-30'	30-155'	145'
PZ-205-AS	Alluvium	Water Table	35	Continuous from 25 to 35'	0-35'	--	25'
PZ-205-SS	Salem/St. Louis Limestone	50' into Bedrock	105	Continuous	0-50'	50-105'	25'
PZ-206-SS	Salem/St. Louis Limestone	Water Table	125	Continuous	0-50'	50-125'	115'
PZ-207-AS	Alluvium	Water Table	40	Continuous	0-40'	--	30'

* or limestone sequence below the shales of the Warsaw Shale. See text for discussion.

TABLE 5-1

RATIONALE OF PROPOSED PIEZOMETERS
REMEDIAL INVESTIGATION

Piezometer	Aquifer to be Characterized	Zone to be Characterized	Estimated Depth (Feet)	Sampling Requirements	Estimated Alluvial Interval	Estimated Bedrock Interval	Estimated Depth to Groundwater
PZ-208-SS	Salem/St. Louis Limestone	Water Table	130	Continuous	0-80'	80-130'	120'
PZ-300-AS	Alluvium	Water Table	30	Continuous	0-30'	--	25'
PZ-300-AI	Alluvium	Intermediate Portion of Aquifer	40	Continuous from 30 to 40'	0-40'	--	25'
PZ-300-AD	Alluvium	Bottom of Aquifer	50	Continuous from 40 to 50'	0-50'	--	25'
PZ-300-SS	Salem/St. Louis Limestone	Top of Aquifer	155	Continuous from 50 to 155'	0-50'	50-155'	145'
PZ-301-SS	Salem/St. Louis Limestone	Top of Aquifer	155	Continuous	0-10'	10-155'	145'
PZ-302-AS	Alluvium	Water Table	15	Continuous	0-15'	--	10'
PZ-302-AI	Alluvium	Intermediate Portion of Aquifer	35	Continuous from 15 to 35'	0-35'	--	10'
PZ-303-AS	Alluvium	Water Table	20	Continuous	0-20'	--	15'
PZ-304-AS	Alluvium	Water Table	20	Continuous	0-20'	--	15'
PZ-304-AI	Alluvium	Intermediate Portion of Aquifer	50	Continuous from 20 to 50'	0-50'	--	15'
PZ-305-AS	Alluvium	Water Table	30	Continuous	0-30'	--	25'
PZ-305-AI	Alluvium	Intermediate Portion of Aquifer	55	Continuous from 30 to 55'	0-55'	--	25'

* or limestone sequence below the shales of the Warsaw Shale. See text for discussion.

TABLE 5-2

LANDFILL GAS ANALYTE LIST

	Risk Based Criteria for Ambient Air	
Parameter	Risk = 1E-04 Air (ug/m3)	HQ = 1 Air (ug/m3)
Dichlorodifluoromethane (Freon 12)		210
Chloromethane	99	
1,2-Dichloro-1,1,2,2,-Tetrafluoroethane (Freon 114)	no values provided	
Vinyl Chloride	2.1	
Bromomethane		5.2
Chloroethane		10000
Trichloroflouromethane (Freon 11)		730
1,1-Dichloroethene	3.6	
Carbon Disulfide		10
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)		31000
Acetone		370
Methylene Chloride	380	
Trans-1,2-Dichloroethene		73
1,1-Dichloroethane		520
Vinyl Acetate		210
cis-1,2-Dichloroethene		37
2-Butanone (Methyl Ethyl Ketone)		1000
Chloroform	7.8	
1,1,1-Trichlorethane		1000
Carbon Tetrachloride	12	
Benzene	22	
1,2-Dichloroethane	6.9	
Trichloroethene	100	
1,2-Dichloropropane	9.2	
Bromodichloromethane	10	
1,3-Dichloropropene (Surrogate for cis-)	4.8	
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)		84
Toluene		420
1,3-Dichloropropene (Surrogate for trans-)	4.8	
1,1,2-Trichloroethane	11	
Tetrachloroethene	310	
2-Hexanone (Methyl Butyl Ketone)	no values provided	
Bibromochloromethane	7.5	
1,2-Dibromoethane	0.81	
Chlorobenzene		21
Ethylbenzene		1000

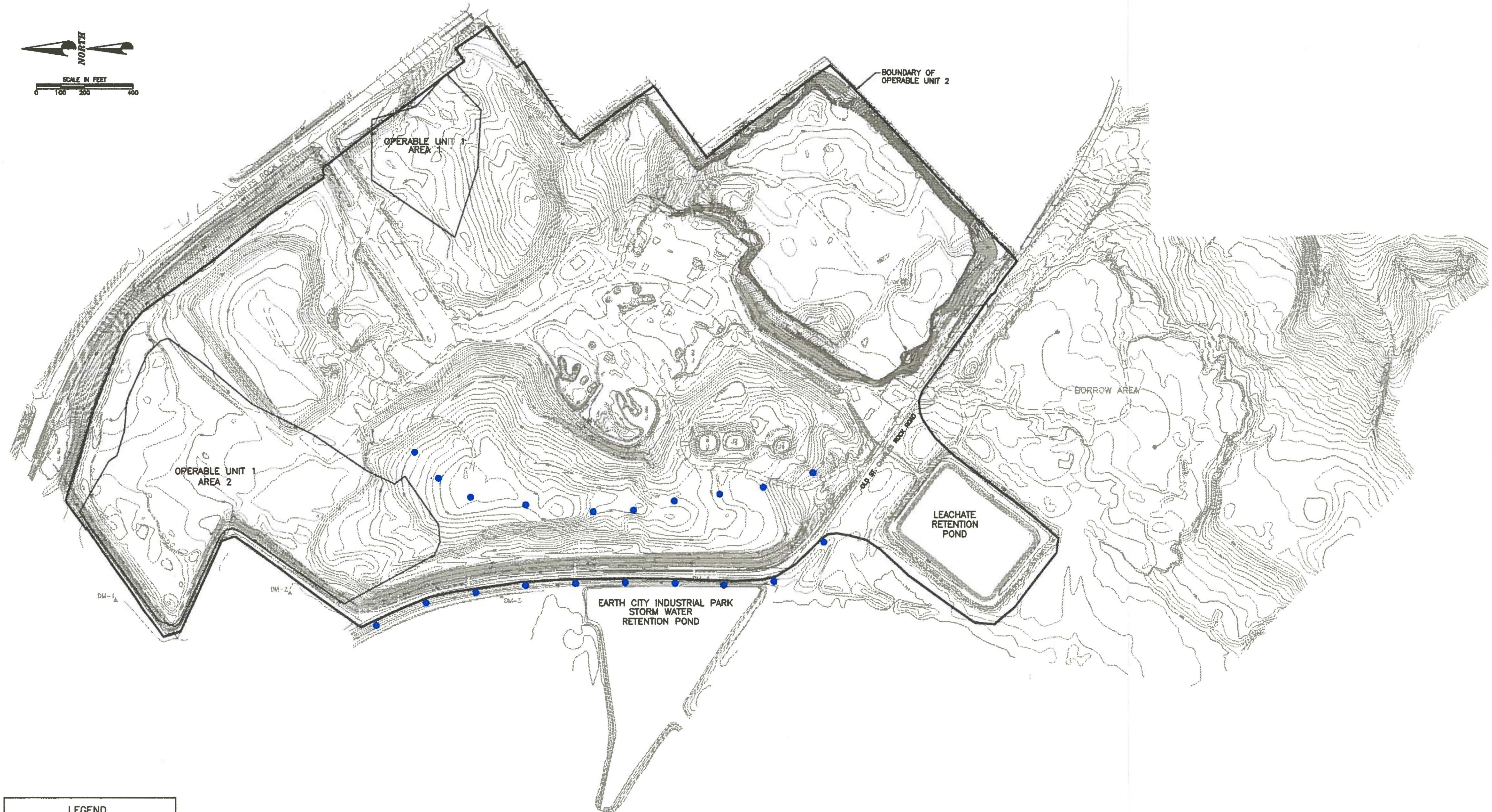
TABLE 5-2

LANDFILL GAS ANALYTE LIST

Parameter	Risk Based Criteria for Ambient Air: Risk = 1E-04 Air (ug/m3)	Risk Based Criteria for Ambient Air: HQ = 1 Air (ug/m3)
p-Xylene		310
m-Xylene		730
o-Xylene		730
Styrene		1000
Bromoform	160	
1,1,2,2-Tetrachloroethane	3.1	
Benzyl Chloride	3.7	
4-Ethyltoluene	no values provided	
1,3,5-Trimethylbenzene		1.5
1,2,4-Trimethylbenzene		1.8
1,3-Dichlorobenzene		320
1,4-Dichlorobenzene	26	
1,2-Dichlorobenzene		210
1,2,4-Trichlorobenzene		210
Hexachlorobutadiene	8.1	

SOURCE: Risk-Based Concentration Table, Fourth Quarter 1994
(EPA Region III, Roy L. Smith)


BOUNDARY OF
OPERABLE UNIT 2
ST. CHARLES ROCK ROAD
OPERABLE UNIT 1
AREA 1
ACTIVE
PERMITTED
SANITARY
LANDFILL
(PERMIT #118912)
ACTIVE
PERMITTED
DEMOLITION
LANDFILL
(PERMIT #218912)
LR-104
APPROXIMATE LOCATION OF
LEAKING UNDERGROUND
STORAGE TANK SITE
LR-103
INACTIVE LEACHATE
TREATMENT PONDS
BORROW AREA
OLD ST. CHARLES ROCK ROAD
OPERABLE UNIT 1
AREA 2
INACTIVE LANDFILL
AND MINE SPOIL AREA
LR-102
LR-101
LR-100
LR-105
LEACHATE
RETENTION
POND
EARTH CITY INDUSTRIAL PARK
STORM WATER
RETENTION POND
LEGEND
LR-105 PROPOSED LEACHATE RISER LOCATIONS
AREA OF POTENTIAL WASTE WASTE AND SLUDGE DISPOSAL, YEAR
1941
1953
1958
1965
1968
1971
1974
1977
1979
1982
1985
1989
1977
1979
1982
1985
ALL YEARS
SOURCE: EPA, 1989 AND 1994
NORTH
SCALE IN FEET
0 100 200 400
REV. DATE DESCRIPTION DR. BY APP. BY
CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.
WEST LAKE LANDFILL
OPERABLE UNIT 2
TITLE
PROPOSED LEACHATE RISER
LOCATIONS
Denver, Colorado
Golder Associates
DRAWN TMC
CHECKED CER
REVIEWED WEH
APPROVED
FILE NO. 2848D040
DATE APRIL 1995
SCALE AS SHOWN
JOB NO. 943-2848
DWG. NO. D040
FIGURE 5-1



LEGEND

● PROPOSED LANDFILL GAS SAMPLING LOCATIONS

Golder Associates	Denver, Colorado	TITLE PROPOSED LANDFILL GAS SAMPLING LOCATIONS				
CLIENT/PROJECT LAIDLAW WASTE SYSTEMS INC.	WEST LAKE LANDFILL OPERABLE UNIT 2	DRAWN TMC	DATE APRIL 1995	JOB NO. 943-2848		
		CHECKED CER	SCALE AS SHOWN	DWG. NO./REV. NO. B050		
		REVIEWED WEH	FILE NO. 2848B050	FIGURE NO. 5-2		

LEGEND

PZ-110-K	PROPOSED PIEZOMETER LOCATION
SB-04	PROPOSED SOIL BORING NEAR MW-F2

KEY TO WELL AND PIEZOMETER IDENTIFICATION

MW = MONITORING WELL
PZ = PIEZOMETER
100 SERIES = ADJACENT TO ACTIVE PERMITTED SANITARY LANDFILL
200 SERIES = WITHIN 500 FT. OF ACTIVE PERMITTED SANITARY LANDFILL
300 SERIES = AROUND PERMITER OF INACTIVE LANDFILL

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.
WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE
PROPOSED PIEZOMETER AND SOIL BORING LOCATIONS

Golder Associates
Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D006
FILE NO.	2848D006	FIGURE	5-3

LEGEND

PZ-110-KS	PROPOSED PIEZOMETER
D-90	EXISTIMG GROUNDWATER MONITORING WELL
GC-2	EXISTING GAS COLLECTION MANHOLE
Q71	EXISTING LEACHATE COLLECTION SUMP
W-1	EXISTING GAS WELL

TOPOGRAPHY NORTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1994

TOPOGRAPHY SOUTH OF OLD ST. CHARLES ROCK ROAD: FEBRUARY 1992

NOTE:
PROPOSED PIEZOMETERS AND HIGHLIGHTED WELLS WILL BE INCLUDED IN THE WATER LEVEL MONITORING PROGRAM.

REV.	DATE	DESCRIPTION	DR. BY	APP. BY

CLIENT/PROJECT

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

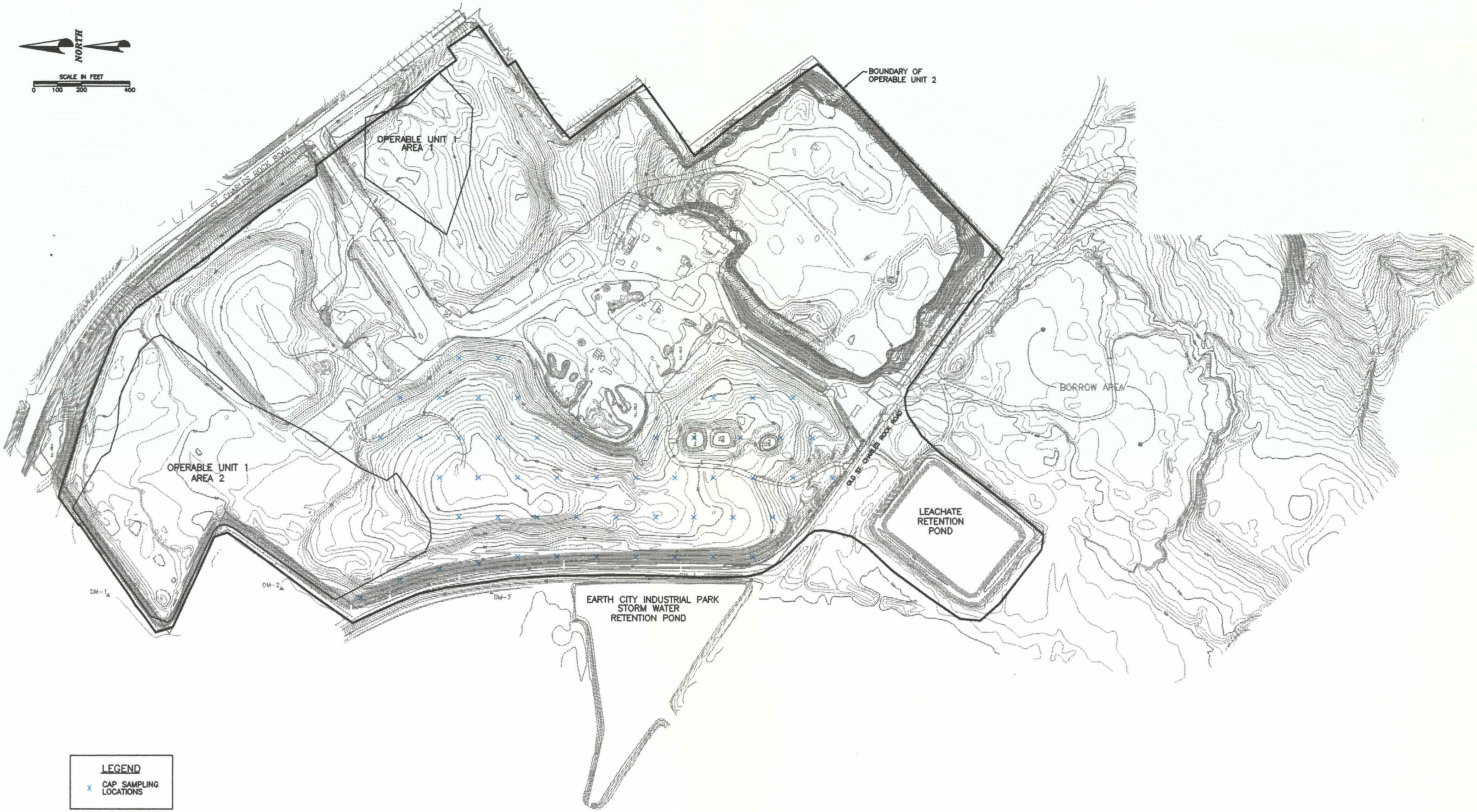
WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE

WATER LEVEL
MONITORING LOCATIONS

Golder Associates
Denver, Colorado

DRAWN	TMC	DATE	APRIL 1995
CHECKED	CER	SCALE	AS SHOWN
REVIEWED	WEH	JOB NO.	943-2848
APPROVED		DWG. NO.	D003
FILE NO.	28480003	FIGURE	5-4



Golder Associates
Denver, Colorado

CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE
PROPOSED CAP INVESTIGATION SAMPLING LOCATIONS

DRAWN	TMC	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	AS SHOWN	DWG. NO./REV. NO.	B048
REVIEWED	WEH	FILE NO.	2848B048	FIGURE NO.	5-5

6.0 SCHEDULE

Figure 6-1 presents the schedule proposed for the RI/FS, constructed in terms of elapsed calendar days from the approval of this Work Plan. For purposes of completing this schedule, an approximate 45-day time frame was assumed for EPA review of reports. As is apparent on the schedule, certain tasks are dependent on that approval and cannot commence until receipt of such approval. Based on the actual time frames required by the EPA for review of these documents, the schedule will have to be revised accordingly. A revised schedule will be submitted to the EPA with the Monthly Progress Reports, as appropriate. Schedule dates for completion of field activities or the submission of deliverables which fall on weekends or holidays will be effective on the following business day. Activities that are weather/climate dependent (e.g., surface water sampling) may be delayed until suitable weather conditions occur. If this results in schedule changes, the EPA will be advised of the necessity for such changes.

The AOC defines the duration of certain portions of the RI/FS work. Certain activities described in the AOC will be conducted only if determined to be necessary based on evaluations of data generated as the RI progresses. The schedule presented in Figure 6-1 assumes that none of these additional activities will be required. Additionally, certain activities, such as EPA development of the baseline risk assessment and document review, are not under the control of Laidlaw Waste Systems (Bridgeton), Inc. Assumed timeframes for these activities are provided in the schedule depicted in Figure 6-1; deviations from these assumptions may result in a change in the schedule of activities. Table 6-1 summarizes timeframes, deliverable documents, and EPA actions.

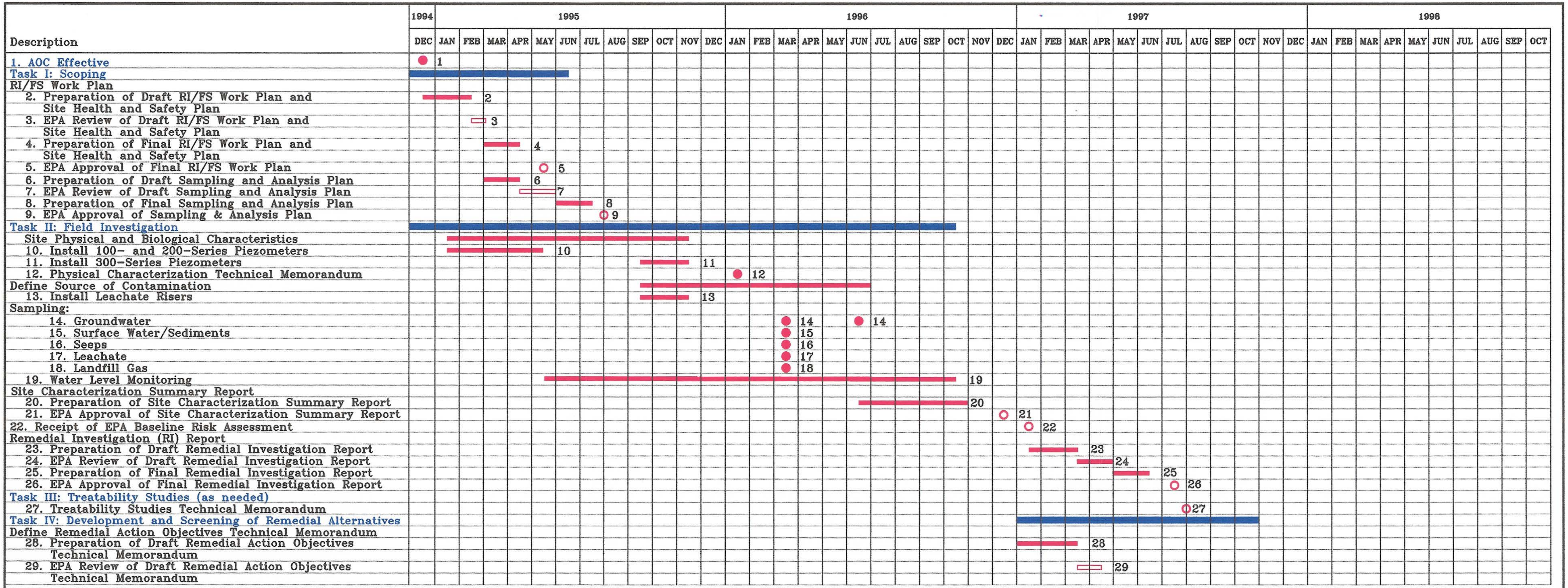
TABLE 6-1

DELIVERABLE SCHEDULE SUMMARY

Deliverable	Submittal Date
Task I: Scoping	
Draft Work Plan[1]	60 days after December 14, 1994 (i.e., February 12, 1995)
Final Work Plan[2]	45 days after receipt of EPA comments on the Draft Work Plan
Draft Site Health and Safety Plan[1]	60 days after December 14, 1994 (i.e., February 12, 1995)
Final Site Health and Safety Plan[2]	45 days after receipt of EPA comments on the Draft Site Health and Safety Plan
Draft Sampling and Analysis Plan[3]	45 days after receipt of EPA comments on the Draft Work Plan
Final Sampling and Analysis Plan[2]	45 days after receipt of EPA comments on the Draft Sampling and Analysis Plan
Interim Action Work Plan	As necessary
Task II: Site Characterization	
Monthly Progress Reports[2]	Monthly
Physical Characterization Technical Memorandum[3]	60 days after completion of "300-" series piezometers
Site Characterization Summary Report[3]	30 days after completion of water level monitoring
Draft Remedial Investigation Report[2]	60 days after receipt of the EPA's Baseline Risk Assessment
Final Remedial Investigation Report[2]	45 days after receipt of EPA comments on the Draft Remedial Investigation Report

NOTES:
* The schedule may change based on actual EPA review time.
1. The submittal dates for these deliverables are defined by the AOC.
2. The schedule for these deliverables is defined by the AOC.
3. The schedule for these deliverables is not defined by the AOC and has been assumed.
4. The completion of Task IV and Task V deliverables is dependent on receipt of the EPA's Baseline Risk Assessment.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCHEDULE GANTT DIAGRAM (Page 1 of 2)



Note:
The schedule for Task IV and V activities is dependent upon receipt of EPA's Baseline Risk Assessment.

Golder Associates
Denver, Colorado

CLIENT/PROJECT
LAIDLAW
LAIDLAW WASTE SYSTEMS INC.
WEST LAKE LANDFILL
OPERABLE UNIT 2

TITLE
REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCHEDULE GANTT DIAGRAM

DRAWN	SMA	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	NA	DWG. NO./REV. NO.	B001
REVIEWED	WEH	FILE NO.	2848B001	FIGURE NO.	6-1

REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCHEDULE GANTT DIAGRAM (Page 2 of 2)

Description

Task IV: Development and Screening of Remedial Alternatives (continued)

Define Remedial Action Objectives Technical Memorandum (continued)

30. Preparation of Final Remedial Action Objectives Technical Memorandum
31. EPA Approval of Final Remedial Action Objectives Technical Memorandum

Development and Screening of Remedial Alternatives

32. Preparation of Draft Development and Screening of Remedial Alternatives Technical Memorandum
33. EPA Review of Draft Development and Screening of Remedial Alternatives Technical Memorandum
34. Preparation of Final Development and Screening of Remedial Alternatives Technical Memorandum
35. EPA Approval of Final Development and Screening of Remedial Alternatives Technical Memorandum

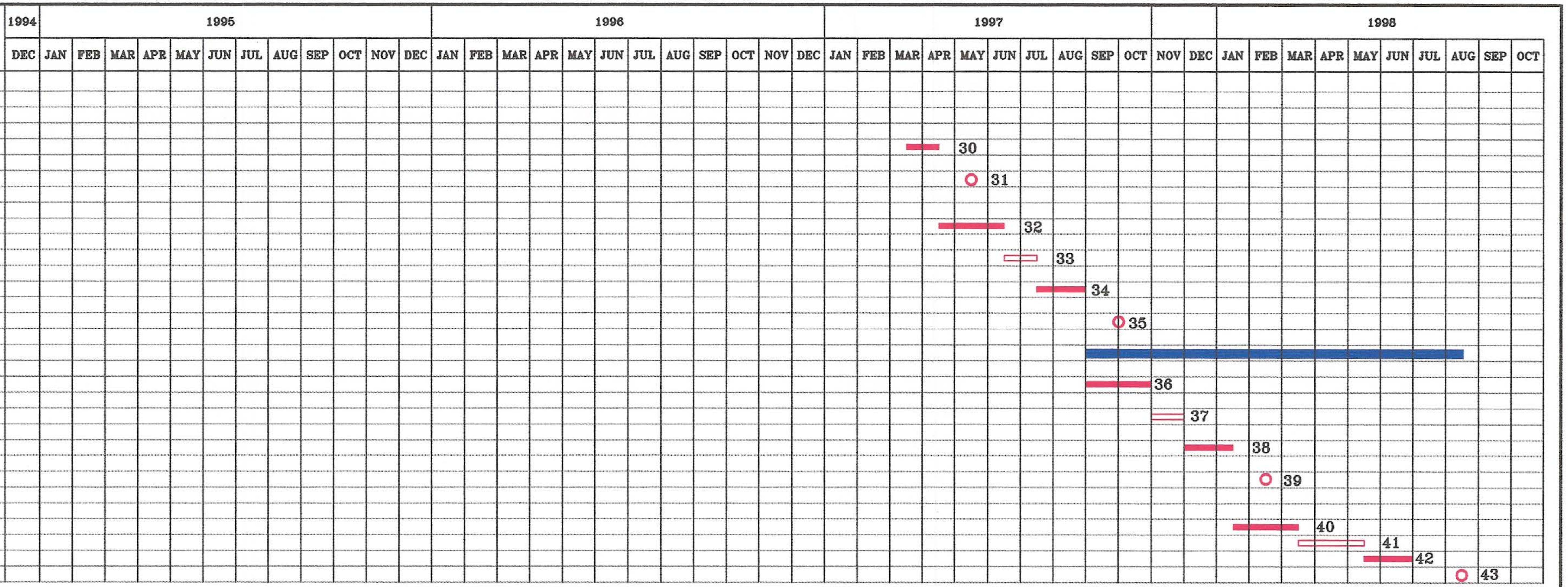
Task V: Detailed Analysis of Alternatives

Comparative Analysis Technical Memorandum

36. Preparation of Draft Comparative Analysis of Technical Memorandum
37. EPA Review of Draft Comparative Analysis of Technical Memorandum
38. Preparation of Final Comparative Analysis of Technical Memorandum
39. EPA Approval of Final Comparative Analysis of Technical Memorandum

Feasibility Study Report

40. Preparation of Draft Feasibility Study Report
41. EPA Review of Draft Feasibility Study Report
42. Preparation of Final Feasibility Study Report
43. EPA Approval of Final Feasibility Study Report



Note:
The schedule for Task IV and V activities is dependent upon receipt of EPA's Baseline Risk Assessment.

Golder Associates — Denver, Colorado

CLIENT/PROJECT: LAIDLAW — LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2

TITLE: REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCHEDULE GANTT DIAGRAM

DRAWN	SMA	DATE	APRIL 1995	JOB NO.	943-2848
CHECKED	CER	SCALE	NA	DWG. NO./REV. NO.	B001
REVIEWED	WEH	FILE NO.	2848B001	FIGURE NO.	6-1

TABLE 6-1

DELIVERABLE SCHEDULE SUMMARY

Deliverable	Submittal Date
Task III: Treatability Studies (if necessary)	
Treatability Studies Memorandum[3]	45 days after receipt of EPA comments on the Draft Remedial Investigation Report
Identification of Candidate Technologies Memorandum	as necessary
Treatability Testing Work Plan	as necessary
Treatability Study Sampling and Analysis Plan	as necessary
Treatability Study Health and Safety Plan	as necessary
Treatability Study Evaluation Report	as necessary
Task IV: Development and Screening of Remedial Alternatives*	
Memorandum on Remedial Action Objectives[2]	60 days after receipt of the EPA's Baseline Risk Assessment
Development and Screening of Remedial Alternatives Technical Memorandum[3,4]	30 days after EPA approval of the Memorandum on Remedial Action Objectives

NOTES:
* The schedule may change based on actual EPA review time.
1. The submittal dates for these deliverables are defined by the AOC.
2. The schedule for these deliverables is defined by the AOC.
3. The schedule for these deliverables is not defined by the AOC and has been assumed.
4. The completion of Task IV and Task V deliverables is dependent on receipt of the EPA's Baseline Risk Assessment.

TABLE 6-1

DELIVERABLE SCHEDULE SUMMARY

Deliverable	Submittal Date
Task V: Detailed Analysis of Remedial Alternatives*	
Draft Comparative Analysis Technical Memorandum[3,4]	30 days after EPA approval of the Development and Screening of Remedial Alternatives Technical Memorandum
Final Comparative Analysis Technical Memorandum[2,4]	45 days after receipt of the EPA comments on the Draft Comparative Analysis Technical Memorandum
Draft Feasibility Study Report[3,4]	30 days after EPA approval of the Final Comparative Analysis Technical Memorandum
Final Feasibility Study Report[2,4]	45 days after receipt of the EPA comments on the Draft Feasibility Study Report

NOTES:

* The schedule may change based on actual EPA review time.

1. The submittal dates for these deliverables are defined by the AOC.
2. The schedule for these deliverables is defined by the AOC.
3. The schedule for these deliverables is not defined by the AOC and has been assumed.
4. The completion of Task IV and Task V deliverables is dependent on receipt of the EPA's Baseline Risk Assessment.

7.0 PROJECT MANAGEMENT

The purpose of this section of the Work Plan is to define the administrative and institutional tasks necessary to support the remedial investigation at the West Lake Landfill. This section summarizes the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures.

7.1 Project Organization and Responsibilities

Laidlaw Waste Systems (Bridgeton), Inc. as sole respondent and party to the AOC, will respond directly to the EPA for implementation of the OU-2 RI/FS. Laidlaw Waste Systems (Bridgeton), Inc. has entered into a contract with Golder Associates Inc. (Golder) for the performance of this RI-FS. Golder, an international engineering consulting firm, will provide professionals for the design, oversight, and performance of this work, and secure qualified subcontractors for certain tasks. Resumes for the key personnel were previously forwarded to EPA for review. The responsibilities of the key technical personnel are described below.

Project Manager

The Project Manager will provide technical and administrative oversight for Golder in performance of the tasks described in this Work Plan. The Project Manager will work with Laidlaw Waste Systems (Bridgeton), Inc. to communicate with the EPA during implementation of this Work Plan. The Project Manager will have overall responsibility for the quality of work provided by Golder.

The responsibilities of this position will also include providing technical and administrative coordination for Golder in performing this Work Plan. The Project Manager will have direct responsibility for planning and implementing the work specified in this Work Plan. The Project

Manager will work with the Health and Safety Officer, Field Team Leader, Data Management/QA Officer, and Golder staff and subcontractors to implement this Work Plan.

Mr. Ward Herst will serve as Project Manager.

Health and Safety Officer

Golder recognizes the importance of Health and Safety on CERCLA projects such as the West Lake Landfill OU-2 RI/FS. Golder will assign Health and Safety responsibilities to the following personnel categories:

- Corporate Health and Safety Officer;
- Project Health and Safety Officer; and,
- Site Health and Safety Officer.

The Corporate Health and Safety Officer will ensure that the RI/FS activities are conducted in compliance with overall company requirements.

The Project Health and Safety Officer (HSO) will be responsible for implementation of the Site Health and Safety Plan and administration of all related activities. The Project HSO will provide expertise regarding the evaluation of chemical and radiological data. The Project HSO will direct the Site Health and Safety Officer, report to the Project Manager, and coordinate activities with other project personnel.

Mr. William Hager, CIH, will serve as Corporate Health and Safety Officer. Mr. Christopher Rife will serve as the Health and Safety Officer. Mr. Brian Tilton will serve as Site Health and Safety Officer.

Field Team Leader

The Field Team Leader will be responsible for coordinating all site field activities as part of this Work Plan. He will be responsible for scheduling and coordination of Golder staff and subcontractors to perform the field activities specified herein. The Field Team Leader will report to the Project Manager and Health and Safety Officer, and coordinate activities with other project personnel.

Mr. Brian Tilton will serve as the Field Team Leader for this project.

Data Management/QA Officer

The Data Management/QA Officer (DMO) will be responsible for the compilation, reduction, storage, and evaluation of the data generated during the activities of this Work Plan. The DMO will report to the Project Manager and will coordinate activities with the other project officers.

Dr. Jay Corgiat will serve as the Data Management/QA Officer for this project.

7.2 Reporting Requirements

Data developed during the RI will ultimately be the basis for formulating the FS and the Record of Decision (ROD) for OU-2. The data can also be used as baseline information to monitor the progress and adequacy of corrective measures, such as the presumptive remedy (containment). The Sampling and Analysis Plan (SAP, Appendix A) presents field procedures and protocols to be implemented during data collection activities. These procedures will be followed during field activities as much as practicable. Periodically, unforeseen conditions will necessitate modification of established procedures. If the deviation is a single variation, Laidlaw Waste Systems (Bridgeton), Inc. or Golder will record the following information in the daily field log, and will provide written notification to the EPA of the change:

- The reason or reasons requiring a deviation from the stated procedure;
- A detailed description of the alternative method used;
- A rationale for selection of the alternative method and possible implications for data usage; and,
- A copy of this information will be placed in the project QA/QC file for future reference.

If the deviation is a permanent modification to field procedures or impacts the quality of data collected, the procedures described above will be followed and the EPA will be notified before initiation of the permanent procedure modification.

7.2.1 Required Documents

The following documents are deliverable to the EPA according to the schedule discussed in Section 6.0:

- Draft *Work Plan*
- Final *Work Plan*
- Draft *Site Health and Safety Plan*
- Final *Site Health and Safety Plan*
- Draft *Sampling and Analyses Plan*
- Final *Sampling and Analysis Plan*
- Monthly Progress Reports
- Draft *Site Characterization Summary Report*
- Final *Site Characterization Summary Report*
- Draft *Remedial Investigation Report*
- Final *Remedial Investigation Report*
- *Treatability Studies Memorandum*
- *Memorandum on Remedial Action Objectives*

- *Development and Screening of Remedial Alternatives Technical Memorandum*
- Draft *Comparative Analysis Technical Memorandum*
- Final *Comparative Analysis Technical Memorandum*
- Draft *Feasibility Study Report*
- Final *Feasibility Study Report*

Monthly written progress reports will be provided to the EPA in accordance with the AOC. Reports will be submitted on the tenth business day of each month and at a minimum, these reports will include the following:

- A description of the actions which have been taken to comply with the AOC during the proceeding month;
- All validated results of sampling and tests, and all other validated data related to the AOC and received by the Respondent during the reporting period;
- A description of the work planned for the next two months, with schedules relating such work to the overall project schedule for RI/FS completion; and,
- A description of all material problems encountered and any anticipated material problems, any actual or anticipated material delays, and solutions developed and implemented to addressing actual or anticipated material problems or delays.

7.3 Data Management Plan

7.3.1 Introduction and Objectives

This data management section presents a program to systematically manage information acquired during OU-2 RI/FS activities at the site. This section describes the procedures to track information, measurements and observations, as well as a system to uniformly record project data. In addition, a summary of likely data presentation displays to be used for both raw data and final data that are generated are discussed below.

The data management section has been designed to satisfy the following objectives:

- Identify and establish data as documentation materials and procedures for the OU-2 RI/FS activities;
- Develop and establish project file requirements to allow collection and tracking of project materials; and,
- Provide anticipated formats to be used to present raw data and conclusions of the OU-2 RI/FS activities.

An extensive amount of site characterization data, as well as records, documents, correspondence, and other critical information, will be generated during the OU-2 RI/FS activities at the site. These data and other information will be used to evaluate the need for, and the selection of, remedial actions at the site. The integrity of the data and information is critical to the quality of the final decision. Therefore, it is essential that the data and information be properly managed to provide for access by authorized persons and the adequate tracking of receipt, storage, and control both during and after the RI/FS process.

This Data Management Plan describes the types of data and information that are expected to be collected and the types of procedural controls that will be enacted to assure their integrity. The procedural controls comprise a Data Management System (DMS) that is also described within this section.

7.3.2 Types of Data to be Collected and Analyzed

The data and information collected during the RI/FS process have been divided into two categories: technical data and administrative data. These two types of data are discussed in greater detail below.

7.3.2.1 Technical Data

Examples of technical data and information that are generated through the RI/FS process and need to be included in the DMS are provided in Table 7-1. The raw data represent the actual field and laboratory measurements or observations that will be made. The summary data represent the first-order analysis of raw data.

7.3.2.2 Administrative Data

Examples of administrative data and information that are generated through the RI/FS process and need to be included in the DMS are provided in Table 7-2. Administrative data are those required for the performance of the project but cannot be considered field or laboratory data.

A library of applicable EPA guidance documents and other pertinent documents will be maintained.

7.3.3 Data Tracking

As indicated in Section 7.3.1, adequate tracking of the data types listed in Section 7.3.2 must be provided. This section describes the data tracking system that will be employed including project data flow, project documentation materials, and project files.

7.3.3.1 Project Data Flow

A schematic representation of project data flow is included in Figure 7-1. As indicated in this figure, all project information will reside in a central project data base and filing system which will be maintained at the Golder's Denver (Lakewood), Colorado office. Field information collected by Golder's personnel and subcontractors will be recorded using the uniform field data collection sheets described in the OU-2 RI/FS Work Plan, the Field Sampling Plan, the Quality Assurance Project Plan, and in the referenced attachments. These records will be stored in the project data files and pertinent information for use in data assessment will be entered into the project data base for later merging with laboratory results as appropriate. This project data base and filing system provides a means of tracking and assuring that all samples collected in the field can be accounted for through the laboratory and during subsequent stages of data analysis.

Laboratory analysis data, which will be generated by the various chemical laboratories, will be tracked by Golder's personnel through the evaluation of hard copy laboratory results. Laboratory results from a given sample or sample set will be merged with corresponding field records. These data, field observations and records, and laboratory measurements, will be subjected to quality control review by the technical staff, and validated. This quality assured information will then form a final data set in the project data base and file system. Subsequent phases of the data flow chart, as indicated in Figure 7-1, describe the preparation of preliminary data summary information, and the review and refinement of this information resulting in completion of the draft RI and FS reports.

7.3.3.2 Project Documentation Materials

Standardized project forms and formats have been developed for the collection of field data and observations, recording of laboratory information, and routine project communications. Routine project communications will be documented on standardized forms for telephone communications and project memoranda.

7.3.3.3 Project Files

To accommodate the diversity of information that will be accumulated a project filing system will be developed to integrate and track project data and historical information. The system will be structured to permit collection of files of one type to be collected together. The skeleton structure of the filing system is shown on Table 7-3. All project records will be logged in and filed to allow for careful tracking of both internal and external communications.

The filing system is fundamental to the orderly referencing of correspondence, reports, calculations, and other information relating to the project. The filing system will be carefully maintained so that information can be readily retrieved when required.

There are a number of basic procedures which must be followed to prevent a breakdown in the system.

- All incoming items must be logged in and stamped with a circulation stamp and given an index reference number and item number. The item is then circulated to the appropriate personnel, as directed by the Project Manager. After circulation, the item is returned to the project secretary and placed into the central file.
- All information must be returned to the files as soon as possible. Copies of items may be made to assist project team members maintaining current information, particularly in calculation files.
- When any file folder, report, drawing, or other data is removed from the file, a file record card will be completed and placed in the file where the folder was removed, until the information is returned.

7.3.4 Data Records

This section describes data record requirements and the project data base including the identification of existing Data Management Systems and data entry and review.

7.3.4.1 Data Record Requirements

A data record for information will be developed to provide all information needed to subsequently analyze and assess the results of the field and laboratory work. Data records require consistent labeling and recording of field observations to facilitate future data reduction and analysis, and to eliminate the need for speculation concerning the quality of observations or the influence of environmental factors on an ultimate result. The following requirements will be met by the data record:

- Unique sample or field measurement code;
- Sampling or field measurement location and sample type;
- Laboratory analysis measured;
- Property or component measured;
- Results of analysis (concentration);
- Detection limit; and,
- Reporting units.

All data collected during the investigation will be accounted for and reported to the EPA, including suspected outliers or samples contaminated due to improper collection, preservation, or storage procedures. Data that are invalidated during the quality control assessment will be marked as such, and reference made to explanations relating to the reasons for data invalidation.

In addition to the above, certain field information must be recorded during sample collection to document procedures used and to indicate the prevailing conditions during the time of sampling. This information includes:

- Name and address of sampler;
- Purpose of sampling;
- Date and time of sampling;
- Sample type and suspected contaminants;
- Sampling location description;
- Sampling method, sample containers, and preservative used;
- Sample weight or volume;
- Number of samples taken;

- Sample identification numbers;
- Amount purged for ground water monitoring well sampling;
- Field observations (prevailing weather conditions and other relevant factors that might influence sample integrity);
- Field measurements conducted; and,
- Name and signature of person responsible for observation.

In addition to the above information, unusual conditions encountered during sampling should be described to allow interpretation of erroneous data at a later date.

Each sample collected as part of this investigation will be assigned a unique sample number that will include some of the information outlined above. These sample identification numbers will be maintained in a project data base to allow tracking of sample status throughout the project.

7.3.4.2 Project Data Base

If, after evaluation, it is decided that an electronic data base system is required, information will be stored, tracked, and evaluated using a PC-based data base system. If an electronic data base is not required, the filing system described above will be used as the data base. If an electronic data base is required, it will be developed using existing software and data handling systems to allow electronic manipulation of data at an early stage, and avoid errors associated with data transcription.

Data management systems often are implemented electronically providing on-line access to data. Golder will evaluate the need for this type of system. An electronic database system of site data is being developed.

7.3.4.3 Data Entry and Review

Data collected in the field will be entered into the data base and hard copy records kept in the project file using a project specific file system. Upon entry of the sample collection data, tracking of these data elements will begin and continue through the life of the project. As laboratory data are merged with field records, new data files will be created that include the current status (validated, etc.) of the information. In addition, review of the data will necessitate the inclusion of comments and remarks (indicated by a data flag) to describe data that is qualified based on failure to meet criteria. These flags will be included in the data base so that final interpretation and assessment of project results will be based upon best available knowledge of the status of each measurement and observation made during the project. Figure 7-1 describes the overall flow of project data and indicates the use of the project data base and files during various stages of data evaluation. To the extent possible, checking, evaluation, and assessment will be done electronically through the use of a computer system to provide a cost effective and efficient means of tracking information, and to reduce transcription errors by eliminating the need for this procedure.

7.3.5 Technical Data Management

The management of technical data including field data, subcontractor data, and calculations are described in this section.

7.3.5.1 Field Data

All field activities will be overseen by Golder. The on-site field personnel will be responsible for entering all daily field activities, measurements and observations in a bound field log book. All data will be recorded legibly in the log book with each day's entries signed and dated. The field log book will be assigned an identification number and all pages will be numbered so that continuity of the log book can be checked. All entries will be made in ink. The personnel responsible for the changes will initial and date all modifications to the log. Upon completion of all field work, the field log book will be assigned a file number and placed in the project file.

In addition to the field log book, daily field report forms will be completed by the field personnel. These forms may include, but may not be limited to, Daily Drilling Reports, Daily Field Reports, and Measurement of Groundwater forms. All forms will be signed, dated, issued a file number, and placed in the project file.

During sampling activities, chain-of-custody forms will be completed and will be sent to the analytical laboratory with the samples to serve as a record of any transfer of possession of samples. Completed chain-of-custody forms will be included with the laboratory analytical results report.

7.3.5.2 Subcontractor Data

All subcontractors must comply with the requirements of the Quality Assurance Project Plan (QAPP). Subcontractors who have QA programs in place are required to submit the QA programs to the Golder Project Manager prior to initiating any project related activities. Subcontractors are responsible for making any necessary revisions to the program to meet the general requirements of the QAPP. If a subcontractor does not have a QA program or if such a program does not meet the requirements of the QAPP, personnel and activities of the subcontractor will be controlled by its requirements. In this regard, all data from subcontractors are reduced, validated and reported in accordance with the QAPP.

Activities of subcontractors will be reviewed periodically by the Golder QA Officer. This review may be conducted through surveillance visits or through reports provided by individual subcontractors. All review findings will be reported to the Golder Project Manager and the reviewed subcontractor. Review results will be included in the appropriate technical memoranda. Also, a discussion of the validity of the data affected by the review results will be incorporated into the appropriate report. All documents supporting major QA/QC actions resulting from reviews or identified during the progress of the work, will be maintained in the project files and quality assurance files. Documents generated by the contract analytical laboratory, or other subcontractor, will be transferred to the project files upon completion of assigned project activities.

7.3.5.3 Calculations

The management of data used in, and generated by, technical calculation including the preparation of calculations and calculation files is discussed in this section.

7.3.5.3.1 General

Engineering calculations include design calculations, quantity estimates, cost estimates and any other material of a similar nature which have permanent value in relation to the project. The following instructions provide the basic procedures to be followed in the preparation of such calculations.

7.3.5.3.2 Preparation of Calculations

Calculations will be legible, concise and prepared in a logical sequence, with the steps adequately described. The result must be understandable to another engineer who may not be familiar with the calculation.

All calculations will be prepared under the direction of the Golder Project Manager. Calculations will be checked. The checker must be of such competence that he could originate the calculations.

Calculations on a computer must be adequately documented. The documentation should be understandable to personnel unfamiliar with the computer program. Computer outputs must always be checked for errors in the program or the information input.

7.3.5.3.3 Calculation Sheets

Calculations shall be prepared on Golder standard calculation sheets. All sheets shall be completed in the title section with:

- Job number;
- File number;
- Sheet number;
- An adequate description of the calculation;
- Analysts' initials and date;
- Checker's initials and date;
- Reference to reports, papers, sketches, drawings and relative correspondence; and,
- QA/QC requirements for the preparation of drawings and specifications.

7.3.5.3.4 Calculation Files

Calculation sheets shall be filed in standard folders and, where applicable, each folder shall contain at least the following information in the order shown:

- Index;
- Summary page(s) listing design objectives, conclusions and recommendations;
- Design criteria;

- Detailed calculations;
- QC/QA requirements for drawings and specifications; and,
- Appendix (reference material).

All calculation file folders will contain the appropriate file number for the project involved, as specified in the File Index.

The folder will be submitted to the Golder Project Manager for approval, who will, if necessary, submit the calculations for the review by other individuals in the project or for peer review by others outside the project.

When the Golder Project Manager has indicated final approval on the calculation file, the calculations will be inserted in the file folder. The file folder number and description will be entered in a calculation log book and the folder will be filed in the appropriate project file.

7.3.6 Document Control

A Document Approval List identifying personnel responsible for document review and approval will be compiled.

Internal and external reports will be given appropriate project file numbers. Distribution of reports will be determined at the time of document preparation. All documents issued for final use will have controlled distribution. Draft documents will not be controlled, but will be stamped DRAFT.

7.3.7 Drawings

No engineering design drawings are expected to be generated in conjunction with the RI/FS activities. If drawings are to be generated, this Data Management Plan will be amended to include the corporate drafting procedures.

7.3.8 Data Presentation

7.3.8.1 Data Presentation Objectives

RI/FS data will be arranged and presented to facilitate interpretation and understanding of this information as it pertains to the overall objectives of the investigation. Typical data displays include tabulation of measurements and observations and graphical displays to summarize information as it relates to conditions present at the site. It is anticipated that raw data will be evaluated predominantly through use of the appropriate tables and screening procedures to evaluate outliers, produce summary statistics and information, and provide validated data sets. Final data will be assessed using a variety of summary procedures, including tabular and graphic forms.

7.3.8.2 Raw Data

Raw data will be evaluated in tabular form using data base software or electronic spread sheets. In addition, data will be sorted and evaluated by examination of its relationship to the site to determine the presence of outliers or invalid data points. Once raw data have been screened and the data assessment has been completed, final tables and displays will be prepared.

7.3.8.3 Final Data

Final project data will be displayed using a variety of tabular and graphical displays to allow interpretation and development of a clear understanding of the nature of any potential contaminant releases from the facility. Graphical displays that might be appropriate for use at the site include the use of bar and line graphs, cross-sectional plots, work and plan maps to examine changes in concentration with time, depth and distance from a suspected source, and display sampling locations and areas.

Spatial distribution of contaminants will be examined through displaying contaminant concentrations on site facility maps representing the various sampling points. Contaminant isopleth maps will also be prepared for groundwater to indicate groundwater flow and contaminant concentration patterns.

Subsurface information will be displayed using vertical profiles and cross-sections to allow an examination of any change in soil or groundwater contamination with depth. Hydrogeologic cross-sections will be used as appropriate to determine more fully the impact of potential releases from the site on groundwater. It may also be necessary to prepare three dimensional plots and/or stratigraphy fence diagrams for adequate description of features present at the site.

Final data reporting will include both graphical and tabular presentations, as well as a discussion of summary statistics and other mathematical simulations used in evaluating project data.

7.3.9 Data Management Plan Scope Relative to Other RI/FS Work Plan Components

The DMS will provide for receipt and control of validated data obtained through implementation of the Work Plan, the Field Sampling Plan, and the Site Health and Safety Plan. The Quality Assurance Project Plan provides specific procedural direction and control for obtaining and analyzing samples in conformance with applicable requirements to assure quality data and results of analyses. The Field Sampling Plan provides the detailed logistical methods to be employed in selecting the location, depth, frequency of collection, etc., of media to be sampled and in methods to be employed to obtain samples of the selected media for cataloging, shipment, and analyses. The data that result from the analyses will be entered into the DMS for subsequent control and tracking. In a similar manner, data from field and bench tests of potential remedial techniques will be entered into the DMS. Procedural controls for such testing are specified in the Quality Assurance Project Plan.

Specific directions and logistical methods to be employed for field and bench testing will be provided prior to initiation of these activities. Site and personnel health data needed to assure worker safety will be specified in the Site Health and Safety Plan, which will also specify the manner in which these data are to be obtained. Personnel health records will be protected and secured in such a way that only authorized personnel will have access to these data.

TABLE 7-1

TYPES OF RI/FS TECHNICAL INFORMATION AND DATA TO BE INCLUDED IN THE DATA MANAGEMENT SYSTEM

Raw data/sample analyses	- Groundwater samples - Sediment samples - Soil samples - Surface water samples - Air samples (from health and safety monitoring) - Soil gas samples (from gas probes) - Personnel exposure monitoring records - Site descriptive information - Pilot/bench test data - Engineering design data
Summary data	- Analytical results of environmental media by time, location, depth, contaminant, etc. - Health risk assessment results - Engineering results
Sampling/analyses/ data handling	- Sampling schedule - Sample collection procedures - Field/laboratory notebooks - Analyses scheduling - Laboratory quality assurance/quality control - Calibration tracking - Instrument coordination - Data entry procedures - Data reduction, validation, storage, and transfer procedures

TABLE 7-2

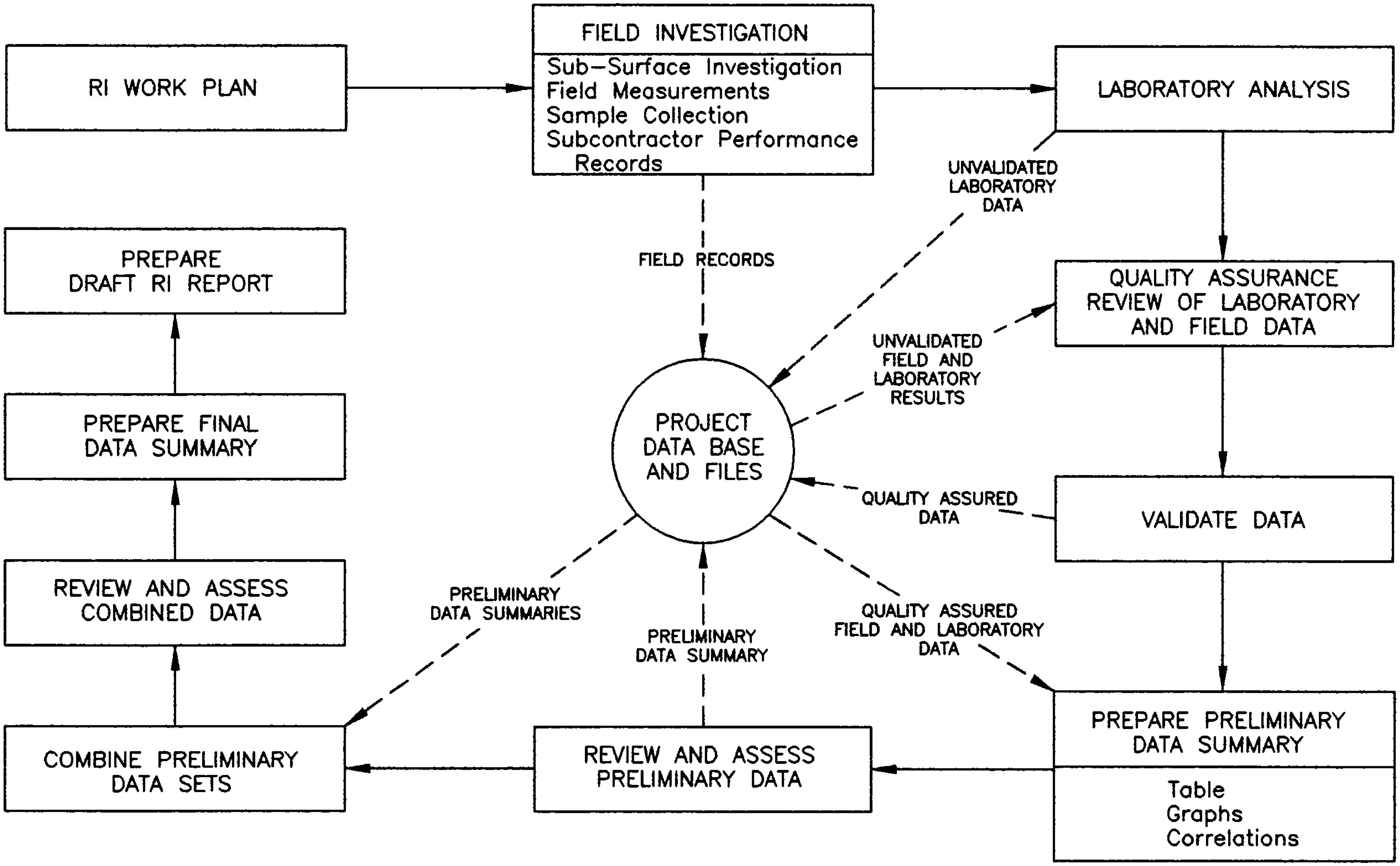
TYPES OF RI/FS ADMINISTRATIVE INFORMATION AND DATA TO BE INCLUDED IN THE DATA MANAGEMENT SYSTEM

Project management	-	Project schedule and milestones
	-	Project cost
	-	Equipment, personnel, and supplies scheduling
	-	Document tracking
	-	Subcontractors
	-	Project quality assurance/ quality control procedures
Personnel	-	Personnel training and qualifications
	-	Occupation exposure reports
	-	Personnel health and safety records
Compliance/regulatory	-	Applicable or relevant and appropriate requirements (ARARs)
	-	Screening levels
	-	Guidance document tracking
	-	Compliance issues
	-	Problem resolution

TABLE 7-3

BASIC PROJECT FILING SYSTEM

FILE NO.	TITLE	ACTIVE	INACTIVE
000	FILE DIRECTORY	____	____
010-019	PROPOSAL/CONTRACT	____	____
020-029	BUDGETARY INFORMATION	____	____
030-039	SUBCONTRACTS	____	____
040-049	MANAGEMENT INFORMATION	____	____
050-059	QUALITY ASSURANCE	____	____
060-069	ADMIN. CORRESPONDENCE	____	____
070-079	PROGRESS REPORTS	____	____
100	CORRESPONDENCE LOG	____	____
110-110	EXTERNAL CORRESPONDENCE	____	____
120-129	INTERNAL MEMORANDA	____	____
130-139	TELEPHONE MEMORANDA	____	____
140-149	TELECOPY AND TELEX	____	____
150-159	MEETING NOTES	____	____
200	REPORT ORIGINALS	____	____
201-250	DRAFTS	____	____
251-299	FINALS	____	____
1300	FIELD INFORMATION	____	____
1301-1305	COPIES OF FIELD NOTEBOOKS	____	____
1306-1310	HEALTH AND SAFETY PLANS	____	____
1311-1315	BORING LOGS	____	____
1316-1320	WELL INSTALLATION LOGS	____	____
1321-1325	GROUNDWATER DATA	____	____
1400	GOLDER LABORATORY INFORMATION	____	____
1401	GOLDER LAB ASSIGNMENT SHEET	____	____
1402-1430	GOLDER LAB TEST RESULTS	____	____
1431-1450	CHEMISTRY DATA	____	____
1500	REFERENCE INFORMATION	____	____
1600	CALCULATIONS	____	____
1700	DESIGN INFORMATION	____	____



CLIENT/PROJECT		TITLE
LAIDLAW WASTE SYSTEMS INC. — WEST LAKE LANDFILL OPERABLE UNIT 2	Golder Associates	EXAMPLE RI DATA FLOW CHART

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8.0 REFERENCES

American Conference of Governmental Industrial Hygienists, 1993. *1993-1994 Threshold Limit Values for Chemical Substances and Physical Agents, and Biological Exposure Indices.* American Conference of Governmental Industrial Hygienists, Office of Technical Affairs. Cincinnati, OH.

ASTM, 1988a. *Standard Method for Particle-Size Analysis of Soils*, D 422-63. American Society For Testing And Materials, Philadelphia, PA.

ASTM, 1988b. *Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rocky and Soil-Aggregate Mixtures*, D 2216-80. American Society For Testing And Materials, Philadelphia, PA.

ASTM, 1988c. *Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*, D 4318-84. American Society For Testing And Materials, Philadelphia, PA.

ATSDR, 1991. *Preliminary Health Assessment for West Lake Landfill, Bridgeton, St. Louis County, Missouri.* Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services. Atlanta, GA.

Banerji, Shankha K., William H. Miller, John T. O'Connor, and Leslie S. Uhazy, 1984. *Engineering Evaluation of Options for Disposition of Radioactively Contaminated Residues Presently in the West Lake Landfill, St. Louis County, Missouri.* College of Engineering, University of Missouri-Columbia. Columbia, MO.

Burns & McDonnell, 1986. *Hydrogeologic Investigation, West Lake Landfill, Primary Phase Report.* Burns & McDonnell. Kansas City, MO.

City of Bridgeton, 1982. *The Zoning Map of the City of Bridgeton.* With amendments through Dec. 15, 1993.

Dames & Moore, 1990a. *Radiological Assessment, Earth City Industrial Park.* Dames & Moore. St. Louis, MO.

Dames & Moore, 1990b. *Phase II Investigation Final Report.* Dames & Moore. St. Louis, MO.

Dames & Moore, 1991. *Phase II Radiological Site Assessment, Earth City Industrial Park.* Dames & Moore. St. Louis, MO.

Elbring, 1973. *Area Map, Plate No. 3.* The Elbring Company. Clayton, MO.

Emmett, L.F., and H.G. Jeffrey, 1968. *Reconnaissance of the Ground-Water Resources of the Missouri River Alluvium Between St. Charles and Jefferson City, Missouri.* U.S. Geological Survey and Missouri Geological Survey and Water Resources. Washington, D.C.

Environment Energy Consultants, Dec. 17, 1979. Letter from E. Edgerley of Environment Energy Consultants to Dave Murray of Reitz & Jens, Inc.

Environment Energy Consultants, Sep. 9, 1982. Report from E. Edgerley of Environment Energy Consultants to William Canney of West Lake Landfill.

Environmental Analysis, July 14, 1989. Report from R.M. Ferris of Environmental Analysis, Inc. to Mike Whitlock of Laidlaw Waste Systems.

Environmental Analysis, Oct. 4, 1990. Report from R.M. Ferris of Environmental Analysis, Inc. to Mike Whitlock of Laidlaw Waste Systems.

Environmental Analysis, Oct. 10, 1990. Report from R.M. Ferris of Environmental Analysis, Inc. to Mike Whitlock of Laidlaw Waste Systems.

Environmental Analysis, Nov. 1, 1990. Report from R.M. Ferris of Environmental Analysis, Inc. to Mike Whitlock of Laidlaw Waste Systems.

Environmental Analysis, Dec. 1, 1990. Report from R.M. Ferris of Environmental Analysis, Inc. to Mike Whitlock of Laidlaw Waste Systems.

Environmental Analysis, Dec. 18, 1991. Report from Jim Bergmann of Environmental Analysis, Inc. to Randy Anderson of Laidlaw Waste Systems, Inc.

Environmental Analysis, July 7, 1993. Report from Jim Bergmann of Environmental Analysis, Inc. to Larry Giroux of Laidlaw Waste Systems, Inc.

Environmental Analysis, Dec. 20, 1993. Report from R. M. Ferris of Environmental Analysis, Inc. to Larry Giroux of Laidlaw Waste Systems, Inc.

EPA, 1983. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1986. *Test Methods for Evaluating Solid Wastes (SW-846)*, Third Edition. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1987a. *Interim Guidance on compliance with Applicable or Relevant and Appropriate Requirements*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1987b. *Data Quality Objectives for Remedial Response Objectives, Volume I, Development Process*. U.S. Environmental Protection Agency. Washington, D.C.

EPA, 1987c. *Laboratory Data Validation Function Guidelines for Evaluating Organic Analyses with Modifications for Use Within Region III*, Technical Directive Document No. HQ-8410-01. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988a. *Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1988b. *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988c. *EPA Contract Laboratory Program Statement of Work for Inorganic Analysis*. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988d. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988e. *EPA Contract Laboratory Program Statement of Work for Organic Analysis*. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1988f. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989a. *Test Methods for Evaluating Solid Waste (SW-846)*, in Federal Register, Volume 54, No. 13. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989b. *Hazardous Waste Management System; Testing and Monitoring Activities (Proposed Rule)*; in Federal Register, Vol. 54, No. 13, pp 3212-3228. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989c. *Preparing Perfect Project Plans*. U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Cincinnati, OH.

EPA, 1989d. *Aerial Photographic Analysis of the West Lake Landfill Site, Bridgeton, Missouri*. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency. Las Vegas, NV.

EPA, 1990. *Streamlining the RI/FS for CERCLA Municipal Landfill Sites*. U.S. Envrionmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1991a. *Aerial Photographic Analysis of the West Lake Landfill Site, Bridgeton, Missouri*. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency. Las Vegas, NV.

EPA, 1991b. *Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1991c. *Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1991d. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1991e. *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response. Washington, D.C.

EPA, 1991f. *Management of Investigation - Derived Wastes During Site Inspections*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response. Washington, D.C.

EPA, 1992. *RCRA Groundwater Monitoring: Draft Technical Guidance*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C.

EPA, 1993a. *Presumptive Remedy for CERCLA Municipal Landfill Sites*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response. Washington, D.C.

EPA, 1993b. *Administrative Order on Consent, Docket No. VII-93-F-005*. U.S. Environmental Protection Agency, Region VII. Kansas City, MO.

EPA, 1994a. *Risk-Based Concentration Tables*. U.S. Environmental Protection Agency, Region III. Philadelphia, PA.

EPA, 1994b. *Administrative Order on Consent, Docket No. VII-94-F-0025*. U.S. Environmental Protection Agency, Region VII. Kansas City, MO.

Foth & Van Dyke, Dec. 12, 1989. Letter from Rodney T. Bloese of Foth & Van Dyke to Joseph G. Homsy of Katten, Muchin and Zavis.

Foth & Van Dyke, Feb. 10, 1994. Letter Report from Rodney T. Bloese of Foth & Van Dyke to Dennis Wike of Laidlaw Waste Systems, Inc.

FWS, 1993. *National Wetlands Inventory, St. Charles, MO.* U.S. Department of the Interior, Fish and Wildlife Service. Twin Cities, MN.

Golder, 1992. *Hazardous Waste Site Investigation Health and Safety Training Course Manual.* Golder Associates Inc. Redmond, WA.

Golder, 1993a. *Environmental Investigation and Health Impact Assessment, Bridgeton Sanitary Landfill.* Golder Associates Inc. Mt. Laurel, NJ.

Golder, 1993b. *Health and Safety Orientation Manual and Accident Prevention Program.* Golder Associates Inc. Redmond, WA.

Golder, 1994. *Draft Report, Environmental Investigation and Exposure Assessment, Bridgeton Sanitary Landfill.* Golder Associates Inc. Mt. Laurel, NJ.

J&L Engineering, 1992. *Bridgeton Landfill Slope Cover and Surface Drainage System Design.* J&L Engineering, Inc., Canonsburg, PA.

Laidlaw, Dec. 29, 1992. Report from Glenn A. O'Bryan of Laidlaw Waste Systems, Inc. to the MDNR Solid Waste Management Program.

Laidlaw, Mar. 30, 1993. Report from Glenn A. O'Bryan of Laidlaw Waste Systems, Inc. to the MDNR Solid Waste Management Program.

Logan, 1964. "Estimating Transmissibility from Routine Production Tests of Waterwells," *Groundwater*, Vol. 2, No. 1, pp. 35-37.

Lutzen, Edwin E., and John D. Rockaway, Jr., 1971. *Engineering Geology of St. Louis County, Missouri.* MDNR Division of Geology and Land Survey. Rolla, MO.

McLaren/Hart, 1994a. *RI/FS Work Plan for the West Lake Site, Bridgeton, Missouri.* May 3, 1993, revised February 28, 1994. McLaren/Hart Engineering Corporation. St. Louis, MO.

McLaren/Hart, 1994b. *Overland Gamma Survey Report, West Lake Landfill Areas 1 and 2, Bridgeton, Missouri.* McLaren/Hart Engineering Corporation, St. Louis, MO.

Midwest Testing, 1993. *Groundwater Hydrology Study, Corporate Woods/Earth City Business Parks, Bridgeton/Earth City, Missouri.* Midwest Testing, Inc. St. Louis, MO.

Midwest Environmental, 1994. *Permit Consolidation Engineering Report.* Midwest Environmental Consultants, P.C. Jefferson City, MO.

Miller, Don E., L.F. Emmett, John Skelton, H.G. Jeffrey, and J.H. Barks, 1974. *Water Resources of the St. Louis Area, Missouri.* Missouri Geological Survey and Water Resources, and U.S. Geological Survey. Rolla, MO.

MNDR, 1993. *Missouri Private Waterwell, Heat Pump System, Pump Installation and Monitoring Well Construction Rules.* Missouri Department of Natural Resources, Division of Geology and Land Survey. Rolla, MO.

National Institute for Occupational Safety and Health, 1990. *NIOSH Pocket Guide to Chemical Hazards.* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. Washington, D.C.

NRC, 1988. *Radioactive Material in the West Lake Landfill.* Division of Industrial and Medical Nuclear Safety, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission. Washington, D.C.

ORAU, 1984. *Survey for Berm Erosion, West Lake Landfill, St. Louis County, Missouri.* Oak Ridge Associated Universities, Oak Ridge, TN.

OSHA-EPA, 1990. *Memorandum of Understanding Between the Occupational Safety and Health Administration and the Environmental Protection Agency on Minimizing Workplace and Environmental Hazards.* November 23, 1990.

Opresko, D. M., B. E. Sample, and G. W. Suter II., 1994. *Toxicological Benchmarks for Wildlife: 1994 Revision.* Environmental Restoration Program, U.S. Department of Energy.

Parker, Sybil P., editor, 1994. *Dictionary of Scientific and Technical Terms*, Fifth ed. McGraw-Hill, New York, NY.

Reitz & Jens, Jul. 27, 1979. Internal memorandum by David E. Murray of Reitz & Jens, Inc.

Reitz & Jens, Apr. 1980. *Memorandum Report, Proposed Expansion of West Lake Landfill Operation, Bridgeton, Mo.* Reitz & Jens, Inc. St. Louis, MO.

Reitz & Jens, May 8, 1980. Letter from David E. Murray of Reitz & Jens, Inc. to Bernie Raines of the Metropolitan St. Louis Sewer District, Industrial Waste Department.

Reitz & Jens, Nov. 24, 1980. Letter from David E. Murray of Reitz & Jens, Inc. to Bernard A. Rains of the Metropolitan St. Louis Sewer District, Industrial Pollution Control.

Reitz & Jens, Feb. 4, 1981. Internal memorandum by David E. Murray of Reitz & Jens, Inc.

Reitz & Jens, Mar. 2, 1981. Letter from David E. Murray of Reitz & Jens, Inc. to William McCullough of West Lake Quarry & Materials Co.

Reitz & Jens, Apr. 13, 1981. Internal memorandum by David E. Murray of Reitz & Jens, Inc.

Reitz & Jens, Jun. 15, 1981. Letter from David E. Murray of Reitz & Jens, Inc. to Mike Duvall of MDNR St. Louis Office.

Reitz & Jens, Jun. 26, 1981. Letter from David E. Murray of Reitz & Jens, Inc. to Carol R. Eighmey of the MDNR Solid Waste Management Program

Reitz & Jens, Nov. 18, 1981. Letter from David E. Murray of Reitz & Jens, Inc. to W.J. McCullough of West Lake Landfill.

Reitz & Jens, Mar. 8, 1982. Memorandum from David E. Murray of Reitz & Jens, Inc, to Bill Canney of West Lake Landfill.

Reitz & Jens, Apr. 14, 1982. Letter from David E. Murray of Reitz & Jens, Inc. to Carol R. Eighmey of the MDNR Solid Waste Management Program.

Reitz & Jens, Sep. 20, 1982. Letter from David E. Murray of Reitz & Jens, Inc. to Thomas R. Gredell of the MDNR Waste Management Program.

Reitz & Jens, Jun. 21, 1983. Letter from David E. Murray of Reitz & Jens, Inc. to John D. Doyle of the MDNR Waste Management Program.

Reitz & Jens, Sep. 9, 1983. Memorandum from David E. Murray of Reitz & Jens, Inc. to William J. McCullough of West Lake Landfill.

Reitz & Jens, Jan. 3, 1984. Letter from David E. Murray of Reitz & Jens, Inc. to Geri Kountzman of the MDNR Solid Waste Management Program.

RMC, 1982. *Radiological Survey of the West Lake Landfill, St. Louis County*, Missouri. Radiation Management Corporation. Northbrook, IL.

SCS, May 17, 1994. Letter Report from SCS Engineers to Dennis Wike, Laidlaw Waste Systems, Inc.

Stock, 1993. *Existing Leachate System Evaluation.* Stock and Associates.

Terracon, Jan. 13, 1992. Letter Report from Ronald Wood of Terracon Environmental, Inc. to Dennis Wike of Laidlaw Waste Systems, Inc.

U.S. Department of Commerce, 1994. *County and City Data Book, 1994.* U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. Washington, D.C.

U.S. Department of Health and Human Services, 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.* Prepared by the National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, U.S. Coast Guard, and U.S. Environmental Protection Agency. Washington, D.C.

West Lake Quarry & Material Co., Jan. 11, 1979. Letter from Wm. J. McCullough of West Lake Quarry & Material Co. to Robert M. Robinson of the MDNR Solid Waste Management Program.

West Lake Quarry & Material Co., Nov. 16, 1993. Memorandum of Agreement.

West Lake Quarry & Material Co., Jun. 16, 1994. Memorandum of Agreement.

Wester, 1992a. *Environmental Investigation for the Development of a Site Health and Safety Plan, Laidlaw Waste Disposal Site, Bridgeton, Missouri.* R.M. Wester and Associates, Inc. St. Peters, MO.

Wester, 1992b. *Phase II Environmental Investigation for the Development of a Site Health and Safety Plan, Laidlaw Waste Disposal Site, Bridgeton, Missouri.* R.M. Wester and Associates, Inc. St. Peters, MO.

York, Oct. 4, 1990. Report from Mark Hartwig of York Laboratories to Chris Segafredo of Environmental Analysis, Inc.

APPENDIX A

SAMPLING AND ANALYSIS PLAN

The Sampling and Analysis Plan is included as a separately bound document.

APPENDIX B

SITE HEALTH AND SAFETY PLAN

The Site Health and Safety Plan is included as a separately bound document.